A Structured Approach for the Operationalization of Strategy Deployment (Hoshin Management)

Thomas Maschek (thomas.maschek@udo.edu)
TU Dortmund University, Germany

Matthias Thürer
Universidade Federal de São Carlos, Brazil

Jochen Deuse
TU Dortmund University, Germany

Abstract
Strategy deployment or Hoshin management was identified as a key to operational success. Yet, it has received little attention in the literature. This study outlines a structured approach to deploy a firm's strategy providing a framework for the alignment of competitive priorities, operational goals and efforts towards continuous improvement.

Keywords: Strategy Deployment, Performance Measurement System, Target Performance Measure

Introduction
Strategy Deployment or Hoshin Kanri was identified as a key to operational success. Yet, while there exists a plethora of concepts to translate a company's corporate strategy into manufacturing strategy in form of competitive priorities, the actual definition of operational measures and targets has received little attention. Further, the few existing approaches lack in specificity and coherence especially on the operations or production level which often hinders their use in practice. In response, this study gives a first outline of a structured and systematic approach to operationalizing goals for production systems.

Translating corporate strategy into manufacturing strategy has been a main focus of operations management for many decades. Skinner's (1969) findings about manufacturing as the missing link in corporate strategy were a milestone in this context. Skinner stated that if a company does not recognize this link, it might end up with a production system that is not competitive. In addition, he remarked that "the set of cause-and-effect factors which determine the linkage between strategy and production operations" is elusive. Starting from there, different approaches to defining manufacturing strategies have been developed. Voss (1995) gives an overview of three main fronts in research and teaching: (i) competing through manufacturing, (ii) strategic choices in manufacturing and (iii) best practice.

First, competing through manufacturing, as defined by Hill (1993), means to identify order-winning and order-qualifying criteria (or competitive priorities), that are to be met in order to be in a market. Orders can be won with competitive price, delivery, quality, product design and variety. Qualifying criteria are the prerequisites for staying in a market, irrespective of winning an order. In this context, goals set for production systems solely depend on the key success factors in a market.

Second, the concept of strategic choices in manufacturing is based upon the need for internal and external consistency. Whereas strategic choices should be contingent on external market factors, on the other hand internal manufacturing strategy should be consistent with these choices (Voss 1995). The product-process matrix (Hayes and Wheelwright 1979) is a good example for such an approach.

Finally, in the concept of best practice manufacturing, choices are based on observing and analyzing superior manufacturing performance results in order to derive the underlying manufacturing practices. Companies need to identify their key processes and attain best practice in order to stay competitive. Best practice and benchmarking have been dominated by Japanese manufacturing practice since the 1980s. Especially the concept of lean production and its principles and methods have received considerable attention. Here, a strong link between operational excellence and performance in a market becomes obvious. A major success factor for the dissemination of lean approaches may lie in a considerably higher specificity of its descriptions of operational best practice. Lean principles and methods like one-piece-flow, kanban or jidoka can be implemented relatively easily. Nevertheless, as Hayes and Pisano (1994) point out, implementing best practices may help to solve specific short-term problems but on the long run lead to a sequence of unaligned and incoherent applications of such principles and method if best practices are not directed towards the creation of unique resources and operational capabilities.

So, best practices are in line with competence theory (De Toni and Tonchia 2002), which claims that competitive advantage is mostly assignable to a company's resources and competencies. In this concept, competition between companies is extended to "alternative organizing logics" (Spring and Boaden 1997) that enable an organization to dynamically adapt to changing conditions. De Toni and Tonchia (2002) also point out that papers on relations between manufacturing strategy and competence theory are rare. Moreover, they subsume manufacturing performance objectives, the respective choices of intervention and policies of production resources' management in a framework of manufacturing strategy. Clark (1996) underlines that the approaches to integrating competencies and manufacturing best practices should be directed at adopting "advanced manufacturing concepts, build the capability to do them better than your competitors, and outperform them". In this context, competence and capability become synonymous (Spring and Boaden 1997).

Following this view of the organization, competitive advantage is based on the dynamics of how an organization acquires, creates, develops and manages its resources. One of the key concepts in this context is continuous improvement (CI). For example, Bessant and Francis regard CI processes in manufacturing as a key factor in gaining competitive advantage and consider it as an example of dynamic capability (Bessant and Francis 1999). They further suggest that CI's strategic advantage is a set of behavioral routines in a "process of focused and sustained incremental innovation" that is hard to copy; it is this set of routines or knowledge which often presents the firms most valuable resource. CI then can be described as an internalized capability of exploiting existing resources and/or of dynamically reacting to changing conditions and requirements in manufacturing that evolves over time. One of its main characteristics is a scientific approach to management, a "dynamic scientific process of acquiring knowledge" (Shewhart and Deming 1939). This usage of the scientific method of testing hypotheses leads to CI's fundamental justification. For CI to be successful, its routines need to be appropriately designed to allow for the required degree of change (see e.g. Feldman and Pentland 2003) i.e. the right balance between exploitation of existing and exploration of new capabilities. To achieve this, CI needs to be guided by continuous measurement of performance and setting of appropriate goals. In most cases, CI efforts are closely linked to lean principles, especially the elimination of waste. Lean tools like Value Stream Mapping assist in identifying wastes but lack in a scientifically rigorous prioritization of improvement targets (Mohanraj et al. 2011).

Out of the above discussion it becomes clear that for a company to stay competitive it is vital to create unique resources or capabilities translating corporate goals into manufacturing strategy and operational targets for the production system. It is this translation into appropriate and meaningful metrics and targets at each level in the organization, i.e. the way how a company manages and creates its resources, which determines its competitive advantage. However, despite its importance, a structured and scientifically grounded approach especially at the operations level is missing. This study provides a first step towards the creation of such an approach. First, we review the literature on strategy deployment and position our framework. Next, we discuss performance metrics and operational rules which govern the interaction between those metrics. Finally, the proposed framework is outlined and it is shortly discussed how it can be used in order to operationalize goals for manufacturing processes.

Strategy Deployment and the Position of the Proposed Framework

Clark (1996) claims that in manufacturing, the superiority of advanced manufacturing systems like lean production should be combined with traditional approaches to strategic management of manufacturing. The challenge is to define goals for the operational level which are aligned with the corporate and manufacturing strategy. In addition such goals should be defined in such a way that they enable organizational learning, the creation of knowledge as a unique resource and thus superior operating capabilities. In this article the idea of a structured approach to defining operationalized goals is explored.

Bessant and Caffyn (1997) define a model describing the evolution of CI performance where the key transition is from structured and systematic but still unaligned routines at single processes towards an aligned CI process which links local activities with broader strategic goals. They underline that the key enabler for this step is the introduction of a procedure to set "a clear and coherent strategy for the business" and to deploy it "through a cascade process which builds understanding and ownership of the goals and sub-goals" (ibid.). Here again, an approach from Japanese manufacturing systems called 'Hoshin Kanri', often referred to as 'Policy Deployment' is a well-known benchmark. It basically consists of a set of "nested experiments" (Jackson 2006) carried out on different hierarchical levels of an organization.

Figure 1 depicts a Policy Deployment model that underlines this hierarchical and experimental construction. On a strategic management level, long-term goals are set which then are sequentially broken down into shorter-term goals for use at lower levels. Feedback loops allow adjustments in case the predicted effect took not place, i.e. the original hypothesis is falsified. While Hoshin Kanri is applicable to many business processes like product planning and design, purchasing or sales, this article focuses on its usage in the context of manufacturing. Still, it has to be kept in mind that there are interdependencies between different business processes in an organization justifying approaches like e.g. simultaneous engineering.

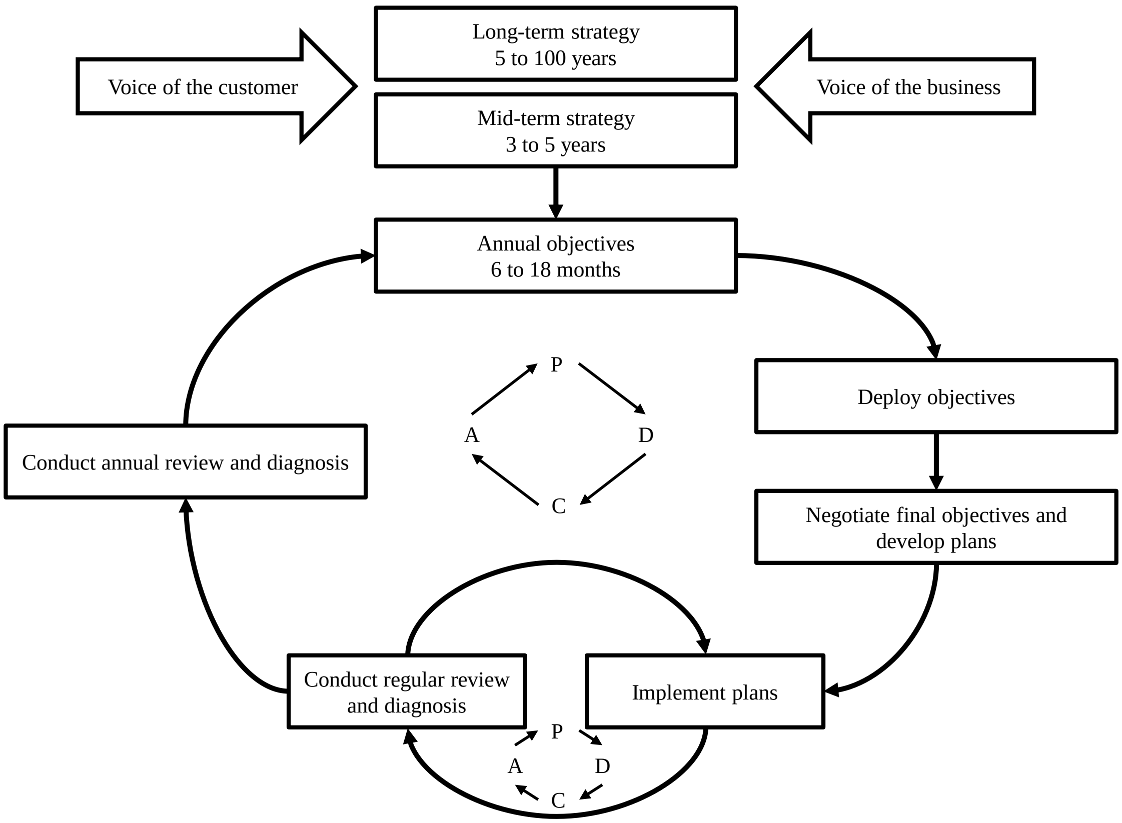

Figure 1 - Policy Deployment Model (Bell Laboratories 1992, Jackson 2006)

Some approaches to CI of manufacturing processes currently described in the literature refer to Hoshin Kanri methods for goal generation. Spear (1999), for example, proposed to align all improvement steps towards an ideal state or so-called 'North Star'. Rother (2009) takes up this idea and integrates it into his capability-centered approach of CI-routines. Rother also connects Policy Deployment's hierarchical structure with the structure of manufacturing processes. Staying within the lean terminology, he claims that a 'North Star' should be broken down into mid-term challenges on a value stream level and finally to short-term target conditions for smaller manufacturing cells or single processes. This is a deductive process, i.e. the 'North Star' represents the general, often abstract objectives of the firm while the final target conditions should be real, measurable process specifications and values. For this type of problem, arguably the best approach is the scientific approach. Yet, as pointed out above, a structured and scientifically rigorous approach to deriving challenges or target conditions does not exist.

As indicated in figure 1, manufacturing strategy and thus operationalizing goals for manufacturing are driven by the voices of customer and business. One key concept for transforming the voice of the customer into product requirements is Quality Function Deployment (QFD), another famous best practice approach from Japan (see e.g. Griffin and Hauser 1993). The customer needs then can be linked to product design attributes. Whereas QFD is a systematic approach, it hence focuses solely on product characteristics or rather quality. Other competitive priorities like delivery, cost or flexibility are not addressed.

It is not surprising though, that a main tool presented in the strategy deployment literature for translating customer needs into competitive priorities and specific goals for single manufacturing lines resembles QFD to some degree. This tool is the so-called X-Matrix (Figure 2). The X-Matrix is used to derive goals on the process level from more general profit-oriented business goals. Nevertheless, the X-Matrix suffers from several weaknesses: (i) goals remain rather unspecific and generic; (ii) goals are not derived scientifically or based on a consistent set of rules; (iii) goals correlations to those one level up in hierarchy get evaluated subjectively; (iv) interactions or trade-offs between goals are not considered; and (v) the goals defined are mostly worked on in a project implementation mode which is adversary to CI. The framework proposed in this study seeks to address these weaknesses.

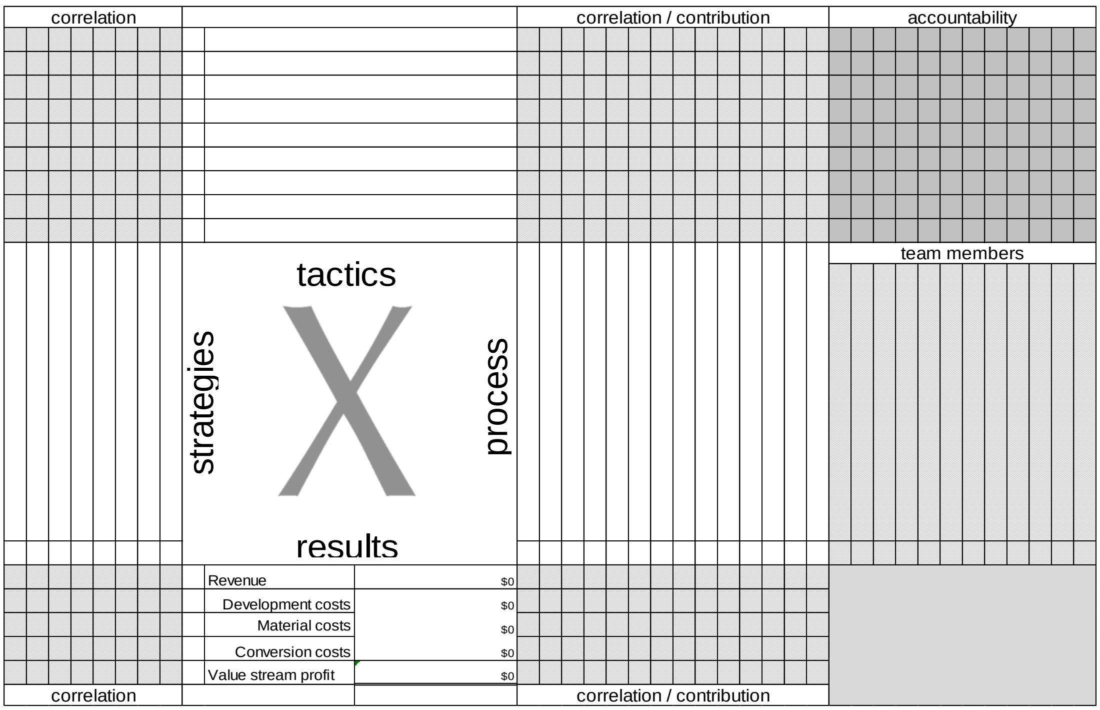

Figure 2 – X-Matrix (Jackson 2006)

Towards a science of manufacturing: Performance Metrics and Operational Rules

As has been underlined above, a consistent set of theory on operational performance with respect to corporate priorities does not exist. There does not seem to be an easy recipe for operational excellence. As Schmenner and Swink remark: “Although recognized as vital to the prospects of any company, operations management suffers in at least some quarters because there is no recognized theory on which it rests or for which it is famous” (Schmenner and Swink 1998). Thus, the need for a science of manufacturing still exists. In the following, we will introduce basic insights and concepts from the literature that can help to derive such a set of theory. Since manufacturing is complex in nature, we claim that every company will in part be able to rely on such theory but still will have to rely on scientific enquiry using CI approaches to enhance, complete and adapt it to its specific conditions. This means, the continuous improvement path is contingent on specific company characteristics.

Performance Measures

“Metrics provide essential links between strategy, execution, and ultimate value creation” (Melnyk et al. 2004). Yet, Melnyk et al. further argue that research has devoted little attention to the design and management of performance measures or metrics. Following Hudson et al. (2001), performance measures should have the following characteristics: (i) derived from strategy, (ii) clearly defined with an explicit purpose, (iii) relevant and easy to maintain, (iv) simple to understand and use, (v) provide fast and accurate feedback, (vi) link operations to strategic goals and (vii) stimulate continuous improvement. Note, that four of these characteristics directly relate to strategy deployment while only three define a quality of a measure.

Trade-Offs between Performance Measures

Two laws have to be considered when setting goals for manufacturing:

- *The law of trade-offs*, which states that a manufacturing plant cannot simultaneously provide the highest levels among all competitors of delivery, quality and flexibility at the lowest cost (e.g. Boyer and Lewis 2002).
- *The law of cumulative capabilities*, which states that improvements in certain manufacturing capabilities precede and enable improvements in other manufacturing capabilities (Ferdows and de Meyer 1990, Flynn 2004, Noble 1995).

Both laws, which seemed to be in conflict – arguing the law of trade-offs for the pursuit of a specific set of capabilities on the expense of others and the law of cumulative capabilities for the pursuit of all capabilities in a sequential manner – were combined by Schmenner and Swink (1998) enhancing the concept of the performance frontier (Clark 1996, Hayes and Pisano 1996). Combined with another two laws which limit any improvements efforts, the theory of performance frontiers claims that the choice of goals and improvement path are bound by a firm’s position compared to its asset frontier ,formed by structural choices related to physical assets, and operating frontier, shaped by infrastructural choices pertaining to operating policies. These two laws are:

- *The law of diminishing returns*, which states that as improvement (or infra-structural change) moves a manufacturing plant nearer to its operating frontier (or its asset frontier for infra-structural change) more resources must be expended to achieve each additional increment of benefit.
- *The law of diminishing synergy*, which states that the strength of the synergistic effects predicted by the law of cumulative capabilities diminishes as a company approaches its asset frontier.

While this theory is useful and may guide continuous improvement, it is often a tricky task to define a company’s asset and operating frontier and most importantly to evaluate its current relative position compared to those frontiers. This requires accurate and comprehensive information about an operation’s structural and infrastructural position and its relation to operating performance. Here, a theoretical foundation is required.

Fundamental Theory of Manufacturing

Decades of research on competing through manufacturing, strategic choices in manufacturing and best practice suggest, there seem to be underlying principles that might be useable as universal guidelines. In addition to the four laws discussed above, Schmenner and Swink (1998) introduce a set of laws, some that can be derived mathematically and some that can be induced from observations, that can help explain differences in factory performance levels (Table 1).

Table 1 – Manufacturing Laws (Schmenner und Swink 1998)

Law	**Description** (quoted from *Schmenner und Swink 1998)*
Law of variability	The greater the random variability, either demanded of the process or inherent in the process itself or in items processed, the less productive the process is.
Law of bottlenecks	An operation's productivity is improved by eliminating or by better managing its bottlenecks. If a bottleneck cannot be eliminated in some way, say by adding capacity, productivity can be augmented by maintaining consistent production through it, if need be with long runs and few changeovers. Non-bottleneck operations do not require long runs and few changeovers.
Law of scientific methods	The productivity of labor (i.e., output per worker-hour of labor) can be augmented in most instances by applying methods such as those identified by the Scientific Management movement.
Law of Quality	Productivity can frequently be improved as quality (i.e., conformance to specifications, as valued by customers) is improved and as waste declines, either by changes in product design, or by changes in materials or processing. Various techniques of the quality movement can be responsible for these improvements.
Law of factory focus	Factories that focus on a limited set of tasks will be more productive than similar factories with a broader array of tasks.

Using these laws, Schmenner and Swink (1998) derive the "theory of swift, even flow", which states that the productivity of any given process "falls with increases in the variability associated with the [product] flow, be that variability associated with the demand on the process or with steps in the process itself". Given this set of rules, which are consistent with further important insights into this topic e.g. by Hopp and Spearman (2008), manufacturing science is able to go beyond best practice and describe fundamental relations between operations and performance. It is these fundamental relations which should guide any effort of strategy deployment and continuous improvement. For example, Gong, Wang & Lai (Gong et al. 2009) conclude in a stochastic analysis of the Toyota Production System that all its principles are directed at exposing and eliminating variability. Here, analytical and empirical manufacturing science merge. Similar, Hopp and Spearman (2008) claim that lean can be defined as protecting throughput from variability at minimum cost – reducing variability in the first place is here often the best option.

Structured Approach to Operationalizing Goals for Production Systems

Enabling a company to integrate the aforementioned theory into a structured approach for translating strategy into operational goals to be used to eventually align production systems towards the 'North Star' is a difficult task. Two things are required: (i) a structured framework which enforces the scientific method for deriving operational targets from strategy and (ii) a model linking operations and performance on a process flow level. Techniques from Business Process Modeling (BPM) can help to visualize and structure process flows but are mostly mere graphical representations of business processes (Bandara et al. 2005). Thus relevant operational rules and metrics have to be added.

On the other hand, it is argued that QFD represents a structure which is appropriate to integrate operational rules and metrics. Some approaches using QFD for the purpose of defining manufacturing goals can be found in the literature. For example, Mohanraj et al. (2011) use QFD for prioritizing wastes identified by the BPM tool of Value Stream Mapping. However, the approach is unstructured and misses a link to strategy as well as an analytical foundation. Olhager and West (2002) use a QFD approach for deploying customer demands on flexibility into manufacturing flexibility. Here, a clear process flow model is missing.

The proposed approach integrates the QFD framework with a process view. It is founded on the QFD framework but in addition integrates contemporary manufacturing theory as well as best practices and a clear process focus.

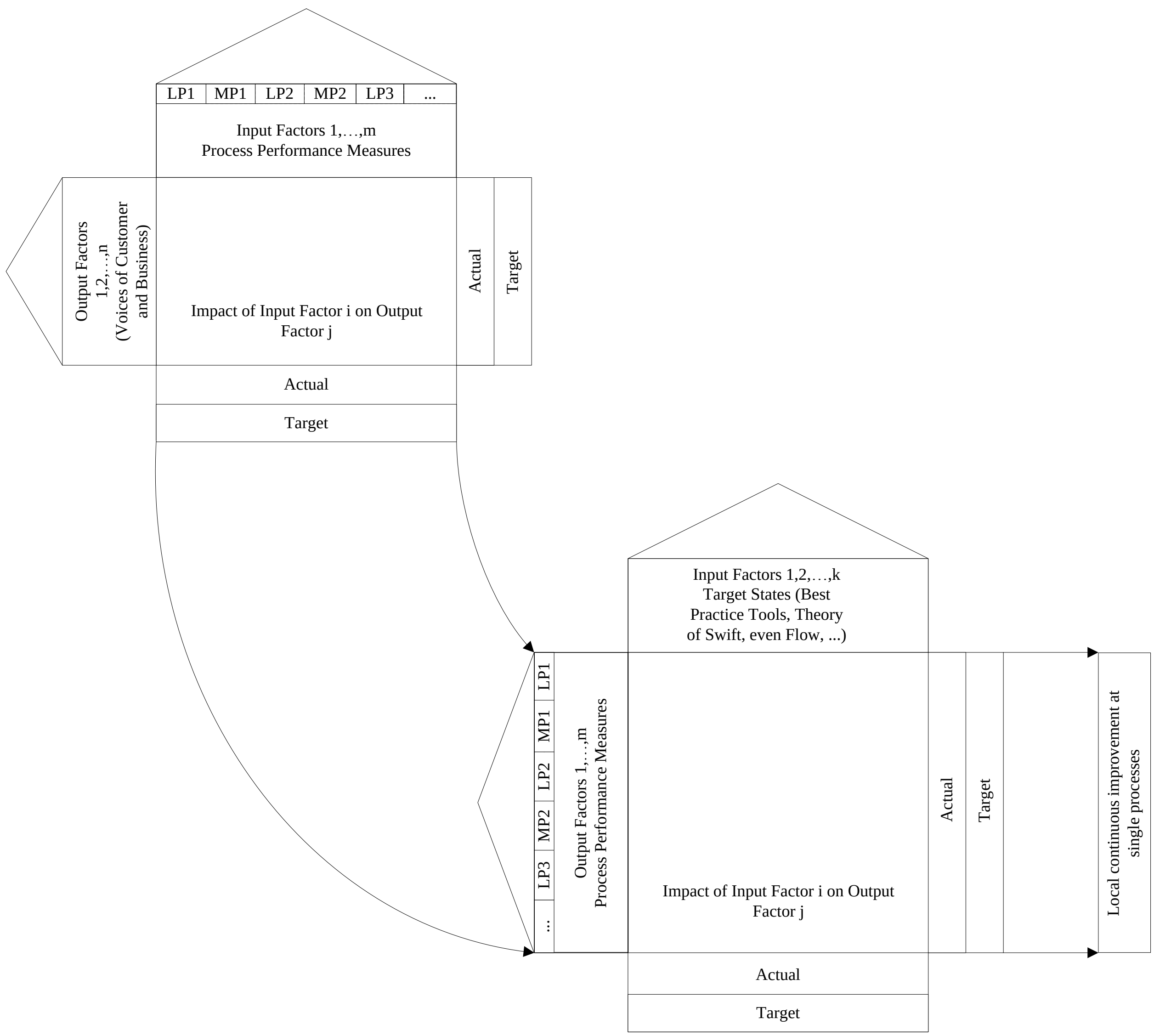

Figure 4 – Framework for setting operations target conditions and continuous improvement

Figure 4 presents a structured approach to operationalizing goals for production processes. It is designed to translate strategy as presented by voices of customer and business into process performance measures for single processes of a process flow which are then broken further down into targets on the flow level. The approach distinguishes between logistics processes (e.g. buffers, conveyors or storage systems) and manufacturing processes (e.g. assembly stations or mechanical processing) to generate a process flow view. The ‘roofs’ in this QFD approach are used to evaluate correlations and tradeoffs between input and output factors whereas the matrices enable an evaluation of input factors’ impact on the output. So, the framework enables the integration of operational rules and metrics which govern input/output relationships with a process view. Finally, the defined target state for the process flow considered is used to guide incremental CI at single processes.

In general, translating strategy into operationalized targets includes a considerable amount of vagueness. Thus, in further research work, the analytical theories at hand as well as theoretically founded best practices will be integrated to provide rules and metrics which allow for moving towards a consistent science for any process flow considered. However, it is obvious that a set of scientifically grounded rules to guide improvement measures for any specific problem encountered in manufacturing will not be at hand. Thus, the need for the crucial capability of performing CI using the scientific method persists. The structured approach outlined here, will also be helpful in defining the appropriate experiments to close these knowledge gaps in specific industry settings.

Conclusion

This study gave a first outline of a structured and systematic approach to operationalizing goals for production systems. The approach extends the well-known concept of quality function deployment to align strategy. While QFD provides the framework or backbone, the concept goes beyond QFD by gathering the main principles of operations management and providing according tools to create rules and routines to structured and coherent goal setting on a process flow level. It is this scientific approach to strategy deployment which is hoped to facilitate the day-to-day life of production managers which are often faced with abstract goals from upper management. Future research now aims at extending the first set of rules and routines derived from the literature and extensive field test to improve and adapt the approach.

References

Bandara, W., G. G. Gable, M. Rosemann. 2005. Factors and measures of business process modelling: model building through a multiple case study. European Journal of Information Systems (14): 347–360.

Bell Laboratories 1992. Policy Deployment: Setting the Direction for Change. AT&T Bell Laboratories, Indianapolis, IN.

Bessant, J., S. Caffyn. 1997. High-involvement innovation through continuous improvement. International Journal of Technology Management **14**(1): 7–28.

Bessant, J., D. Francis. 1999. Developing strategic continuous improvement capability. International Journal of Operations & Production Management **19**(11): 1106–1119.

Boyer, K. K., M. W. Lewis. 2002. Competitive Priorities: Investigating the Need for Trade-Offs in Operations Strategy. Production and Operations Management **11**(1): 9–20.

Clark, K. B. 1996. Competing Through Manufacturing and the new Manufacturing Paradigm: Is Manufacturing Strategy Passè? Production and Operations Management **5**(1): 42–58.

Feldman, M. S., B. T. Pentland. 2003. Reconceptualizing Organizational Routines as a Source of Flexibility and Change. Administrative Science Quarterly **48**: 94–118.

Ferdows, K., A. de Meyer. 1990. Lasting Improvements in Manufacturing Performance: In Search of a New Theory. Journal of Operations Management **9**(2): 168–184.

Flynn, B. 2004. An exploratory study of the nature of cumulative capabilities. Journal of Operations Management **22**(5): 439–457.
Gong, Q., S. Wang, K. K. Lai. 2009. Stochastic analysis of TPS: expose and eliminate variability by highly specifying WCP. International Journal of Production Research **47**(3): 751–775.
Griffin, A., J. R. Hauser. 1993. The Voice of the Customer. Marketing Science **12**(1): 1–27.
Hayes, R. H., G. P. Pisano. 1996. Manufacturing Strategy: At the Intersection of Two Paradigm Shifts. Production and Operations Management **5**(1): 25–41.
Hayes, R., G. P. Pisano. 1994. Beyond World-Class: The New Manufacturing Strategy. Harvard business review (January-February): 77–86.
Hayes, R., S. Wheelwright. 1979. Link manufacturing process and product life cycles. Harvard business review **57**(1): 133–140.
Hill, T. 1993. Manufacturing strategy. Macmillan, Basingstoke, Hampshire.
Hopp, W. J., M. L. Spearman. 2008. Factory physics. McGraw-Hill/Irwin/Irwin, New York, NY.
Hudson, M., A. Smart, M. Bourne. 2001. Theory and practice in SME performance measurement systems.
International Journal of Operations & Production Management **21**(8): 1096–1115.
Jackson, T. L. 2006. Hoshin kanri for the lean enterprise. Productivity Press, New York, NY.
Melnyk, S. A., D. M. Stewart, M. Swink. 2004. Metrics and performance measurement in operations management: dealing with the metrics maze. Journal of Operations Management **22**(3): 209–218.
Mohanraj, R., M. Sakthivel , S. Vinodh. 2011. QFD integrated value stream mapping. International Journal of Productivity and Quality Management **7**(4): 501–522.
Noble, M. A. 1995. Manufacturing Strategy: Testing the Cumulative Model in a Multiple Country Context. Decision Sciences **26**(5): 693–721.
Olhager, J., M. B. West. 2002. The house of flexibility. International Journal of Operations & Production Management **22**(1): 50–79.
Rother, M. 2009. Toyota Kata. McGraw-Hill Publishing, New York, NY.
Schmenner, R. W., M. L. Swink. 1998. On theory in operations management. Journal of Operations Management **17**: 97–113.
Shewhart, W. A., W. E. Deming. 1939. Statistical method from the viewpoint of quality control. The Department of Agriculture, Washington.
Skinner, W. 1969. Manufacturing - missing link in corporate strategy. Harvard Business Review, Boston.
Spear, S. J. 1999. The Toyota production system. George F. Baker Foundation, Harvard University.
Spring, M., R. Boaden. 1997. "One more time: how do you win orders?": A critical reappraisal of the Hill manufacturing strategy framework. International Journal of Operations & Production Management **17**(8): 757–779.
De Toni, A., S. Tonchia. 2002. New production models: A strategic view. International Journal of Production Research **40**(18): 4721–4741.
Voss, C. 1995. Alternative paradigms for manufacturing strategy. International Journal of Operations & Production Management **15**(4): 5–16.