Leagility, New Paradigm Logistic Performance Measurement System

S.A. Kamel Kaya, N. Messaoudi

Abstract— **The link between the lean orientation and the agile model is only possible through the Supply Chain interface (SC) and the DC (Demand Chain), called "leagility." What does this concept cover? How is it achieved? The answer to this second question suggests a multidimensional repository based on the triptych: efficiency, efficacy, and responsiveness, the combination of which allows us to define not only the three determinants but also the related Key Performance Indicators (KPIs). It requires the use of instruments such as the Advanced Available To Promise Mode Batch (AATP MB / Time Real) to achieve a compromise between the objectives of the SC and those of the DC.**

Index Terms— **AATP, Agile, DC, Efficacy, Efficiency, KPI, Leagility, MB, referential, TR.**

I. Introduction

Today we are witnessing a market economy where firms have to respond to customer demands that are personalized and less and less predictable. This evolution has forced companies to consider the customer's need as the basis for any reflection and to organize their internal and external logistical processes. In other words, companies must be able to provide "good products" at "the right time" with "good quantities" in the "right place" at the "best price." Therefore, it is worth emphasizing two features: lean and agile. The system that allows the link between the "Supply Chain" and the "Demand Chain" is referred to as Leagility.

This system represents the interface of the supply chain and demand chain insofar as it combines the set of attributes that are the triptych efficiency / Efficacy/responsiveness. It is necessary to add to these three determinants the criterion of flexibility, the combination of which allows us to obtain what we can call levels of "composite performance." Otherwise expressed, the concept of Leagility stems from the coupling of lean and agile approaches. In this context, our objective is to formulate a multidimensional frame of reference that corresponds to each of the determinants that characterize the Leagility, the combination of which allows us to define not only the three criteria but also the KPIs (Key Performance Indicators) related to them. Also, the implementation of this repository requires the use of a multicriteria decision support tool such as the Advanced Available To Promise Mode Batch/Time Real (AATP MB / TR). This approach allows us to find a compromise between the objectives of the SC and those of DC.

II. Leagility: Concepts and Attributes

As we have already mentioned, the concept of Leagility emanates from the coupling of lean & agile notions. Lean orientation is a characteristic of SC that aims to minimize cost (efficiency). Agility, on the other hand, is a feature of DC, which aims to provide a fast and efficient response to customer expectations. We can then configure our supply chain intent with client-oriented DC and upstream SC.

Figure 1: SC versus DC

Besides, it is possible to make the lean/agile approximation with the concepts of "qualifying advantage" and "winning advantage" [1] as presented in the following table 1

Table 1.

	Qualifying benefits	Winning benefits
Agile logistics chain	Quality / cost / time	level of service
Lean logistics chain	Quality / cost / level of service	Cost

In this context, we can consider leagility as the hybridization of lean and agile paradigms in a global logistic strategy by positioning the decompartmenting point in the most appropriate way to respond to volatile downstream demand and finally bringing the level of proper planning upstream of the decoupling point [2]. We can illustrate the different attributes of the lean, agile, and leagile strings in the following synoptic table.

Manuscript received March 31, 2020
S.A. KAMEL KAYA, Equipe INSCM - Laboratoire de recherche L2MI ENSAM – Moulay Ismaïl, University Morocco
N. MESSAOUDI, EHEC (pôle universitaire de Koléa, Algeria)

Table 2. Comparison of SC lean, agile, and leagile [3].

Distinguishing Attributes	Lean chain	Agile chain	Leagile chain
Market demand	Predictable	Volatile	Volatile and unpredictable
Product variety	Low	High	Moderate
Product life cycle	Long	Short	Short
Customers drivers	Cost	Delays and availability	Level of service
profit margin	Low	High	Moderate
Cost dominant	Physical cost	Marketing Cost	Physics and Marketing
Breaking penalties	Long term	Immediate and volatile	No room for breaks
Purchase policy	Buy the goods	Assign capacity	Shared supply management
Information enrichment	Highly desirable	Mandatory	Essential
Forecasting mechanism	Algorithmic	Advisory	The two / Either
Typical products	Product current consumption	Fashion goods	Product as per customer
Reduction of deadlines Elimination of Muda	Essential	Essential	Desirable
Quick reconfiguration	Essential	Essential	Arbitrary
Robustness	Desirable	Qualifying advantage	Essential
Quality	Arbitrary	Qualifying advantage	Desirable
Cost	Qualifying advantage	Qualifying advantage	Qualifying advantage
Time limit	Winning advantage	Qualifying advantage	Winning advantage
Level of service	Qualifying advantage	Winning advantage	Qualifying advantage
	Qualifying advantage		Winning advantage

It results from reading this table the existence of multiple convergences between the two types of lean and agile management. Therefore, their combination enables us to achieve what we have previously defined as Leagility. We can distinguish three possible combinations of flow management in SC.

Lean and agile channels management.

This type of management makes use of Law 20/80, which reveals that 80% of the volume of demand comes from 20% of the products. Therefore, 20 % of products require a management mode different from the remaining 80%. In the case where the demand for this 20 % is predictable, the lean approach is appropriate; an agile management model can manage the remaining 80%.

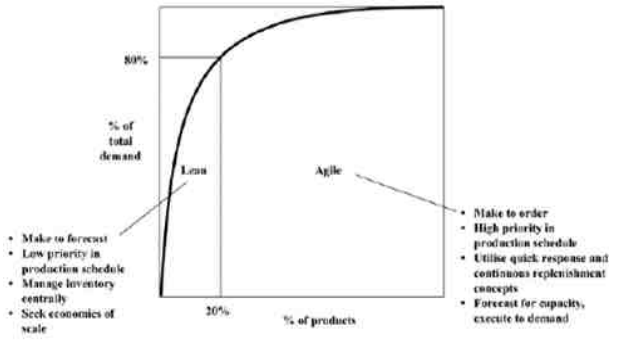

Figure 2. Distribution of V. Pareto.

A. *Successive Management in lean mode then agile*

The principle is that demand may be stable and predictable at one time and temporarily peak at other times. Like seasonal products, whose peak season management mode is agile, low season in lean mode, or the reverse according to the categories of products and the nature of the consumption. In terms of capacity, the off-season lows smooth out activity.

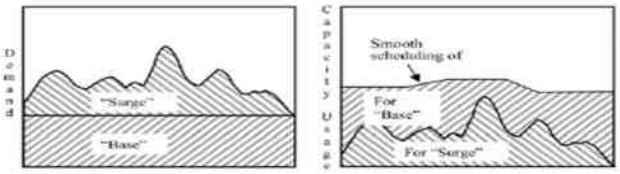

Figure 3 the response to a changing demand [4].

B. *Decoupling of SC*

The decoupling point makes it possible to connect the lean and agile concepts by inserting what we can call "strategic stock" [4]. As illustrated in Figure 4, and using the concept of "delayed differentiation," firms can use lean-based methods up to the point of decoupling (for standardized components) Agility beyond. The concept of delayed differentiation is a critical factor in an agile strategy. Such an industrial concept integrates the elements of product customization throughout the product processing and distribution chain as soon as possible.

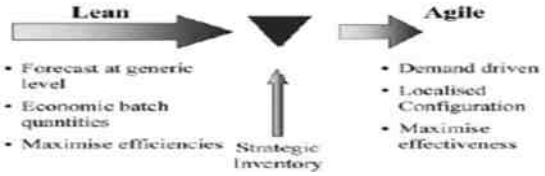

Figure 4. The decoupling point [4].

III. Determination of Evaluation Criteria & Key Performance Indicators (KPI)

The most commonly used model for understanding the concept of Leagility is to express the total value of a product in the form of a ratio that combines qualifying benefits with winning advantages:

Total Value = Quality * Service / Cost * Deadline (1)

We know that the cost is a winning advantage for a qualified lean system, while the quality of customer service is as for a flexible system.

Insofar as quality and deadlines are qualifying advantages for both types of systems, responsiveness is inversely proportional to time (responsiveness decreases if deadlines increase); efficiency and responsiveness are directly proportional to the service quality. We can rewrite the expression as follows:

Total Value = Efficiency * Responsiveness * Efficacy (2)

The total value can, therefore, become better through increased effectiveness, responsiveness, and efficiency, responsiveness, and efficacy, i.e., reducing costs, delays, and improving the quality of service. We can, therefore, achieve the leagility while striving to find a compromise between efficiency, efficacy, and responsiveness. It is, therefore, useful to define precisely each of these concepts, including also the notion of flexibility, which allows us to combine these last three values and reach the leagility.

A. *Efficiency*

Its definition is the adequacy of means and results: "Are the results sufficient given the means used? ". We evaluate performance in terms of efficiency, mainly during the operating phase of the production system. In case of dissatisfaction, it is the pilot (equipment management and maintenance) or management (human system) decisions to intervene.

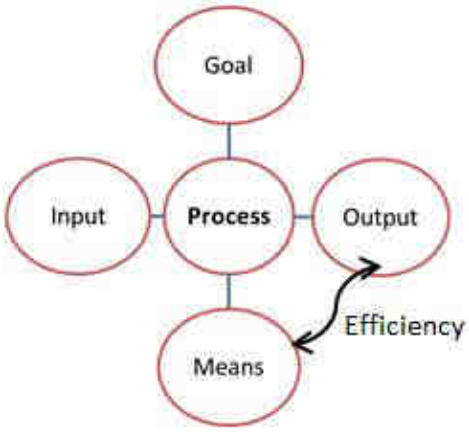

Figure 5. Representation of efficiency.

It is possible to improve efficiency by eliminating Muda (waste), i.e., by reducing the level of inputs and increasing the level of outputs. They present a two-dimensional framework (efficiency and effectiveness, see Fig. 6) to measure the performance of an SC. They indicate that, until now, the majority of firms focus exclusively on the improvement of SC by gains in terms of efficiency (reduction of logistical costs, better utilization of capacity, decrease in stocks, and complete delivery to date). Such improvements sometimes have positive impacts on customer satisfaction and CS effectiveness. Also, the efficiency indicator is the performance of a system. Thus, efficiency is a characteristic of the SC whose cost is the winning advantage. Otherwise expressed, The calculation of efficiency results from the overall cost of order management

, which corresponds to the sum of the costs for receipt of orders, processing, distribution, transport, billing, and installation.

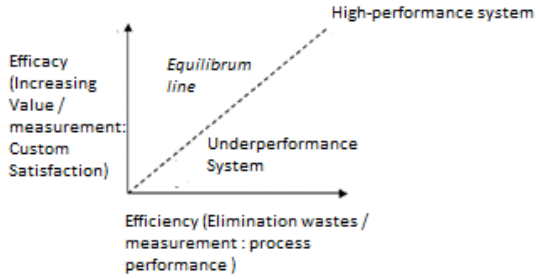

Figure 6. Two-dimensional efficiency / efficacy repository [5].

B. *Efficacy*

It is the match between the result and the resource. The effect of the means refers here to its cause (mechanistic or causal interpretation), whatever the system's purpose. "Did we get to what we intended to do, to what extent was the target set? ". While the effectiveness of the system, which can often be assessed using quality indicators, is not satisfactory, the possible actions concern the internal organization of the system and the different parameters of the adjustments (or action variables) accessible. Thus, it measures the ability of the steering system to meet the objectives assigned to it (see Fig.7).

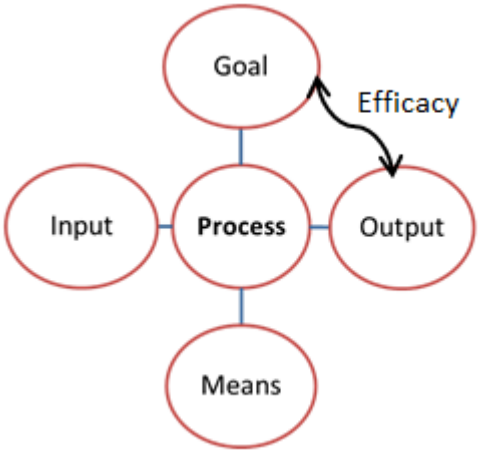

Figure 7. Representation of efficacy

A supply chain's efficiency refers to consumers' subjective preferences and satisfaction of the customer. This situation is likely an improvement through higher value-added. In short, efficiency is the ability to do the right thing, i.e., to respond

precisely to the customer's needs. The degree to which one achieves the objective is a measure of effectiveness. As for the measure of efficacy itself, it is based on the completeness of the order as a key indicator

C. Responsiveness.

It can be defined as the capacity of a production system to respond to disturbances (internal or external to the system) that affect production objectives. Responsiveness helps to achieve agility goals by controlling changes and uncertainties. In other words, it is the ability to respond quickly and correctly to the client's needs. It is measured by response time. As for the measurement indicator, we can use the Normalized Average Delivery Time (NADT), determined from the delivered products.

D. Flexibility

We can define flexibility as the ability of a system to improve the performance of a supply chain. There is, of course, a link between flexibility and responsiveness in the sense that it is not an end, but a means to achieve other goals (see Fig. 8):

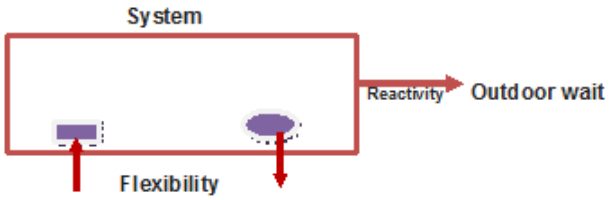

Figure 8. Flexibility and external expectation.

We distinguish two types of flexibility: flexibility in terms of means deployed to improve overall performance and response flexibility that measures the ease with which adaptation can be achieved (in terms of cost or delay). In terms of flexibility, the most common indicator for measuring it remains the number of possible alternatives to the delivery process. The two alternatives, the possibility of substituting products and using several distribution sites, constitute the degree of flexibility. It is important to note that the first three indicators identified are dynamic, i.e., they can change with the system.

Flexibility, on the other hand, has a static pattern. It is a supply chain property [6]. Finally, the internal coherence of the system is a consideration to take into account in the analysis.

IV. Proposal of a Benchmark for the Evaluation of the Performance of the Logistics System

The combination of the three determinants constitutes a three-dimensional referential (see Fig. 9), which allows positioning itself per different possible levels of performance. Thus, we distinguish levels of "pure performance" from those we call "plural performance." The first levels correspond to positioning on one of the three edges: efficacy, efficiency & responsiveness. The combination of this triptych with the concept of flexibility makes it possible to obtain levels of "plural performance."

- Agility level is achieved by combining efficiency & responsiveness;
- The achievement of the level of leagility is effected by agencing the efficiency (which constitutes the lean mode) with the two dimensions translating agility, i.e., efficacy & responsiveness;
- The level of partial responsiveness leagility is the result of the combination of efficiency with one of the criteria of agility (responsiveness);
- The combination of efficiency and efficiency allows us to reach the level of partial leagility oriented efficacy.

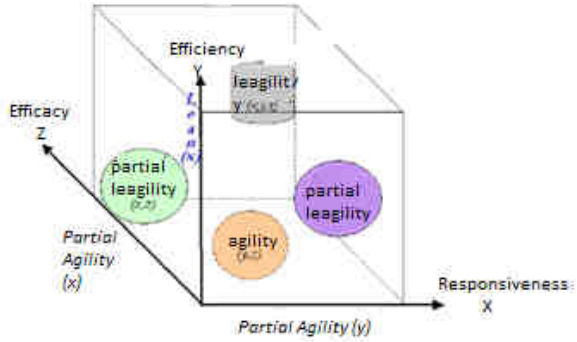

Figure 9. Three-dimensional repository for performance evaluation of the logistics system.

In sum, we emphasize that the three determinants of performance of the logistics system are based on SC / DC's objectives of being able to deliver the "right product," the "right quantity" requested by the customer (efficacy), Responsiveness and minimum cost. In order to facilitate the deployment of this repository, it seems interesting to us to use instrumentation such as the Advanced Available To Promise (AATP). This decision-making mechanism directly combines the available resources (raw materials, work in process & finished products) as well as production and distribution capacities with customer orders to improve overall performance by reducing the gaps between the SC driven by the forecast and the DC-driven by the customer requests. Moreover, many characteristics make it possible to differentiate the AATPs: their mode of execution, the level of availability, their management mode, their extent, or their flexibility [7], as illustrated in Fig. 10.

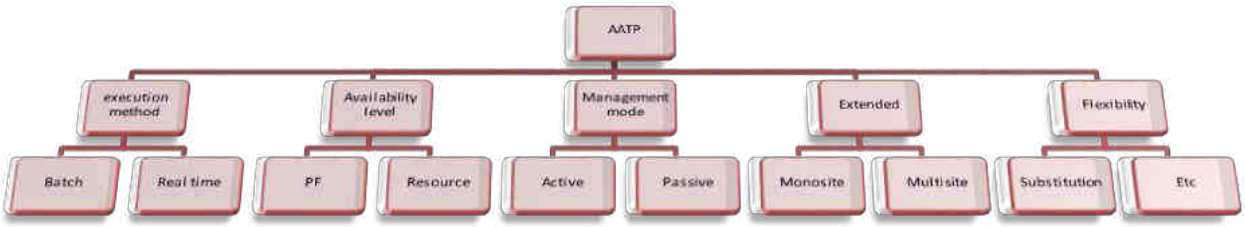

Figure 10. Characteristics of the different AATPs [10]

It follows from the combination of the two characteristics (modes of execution and the level of availability) 4 types of AATP as presented in table 3 below:

Table 3 The different types of AATP (adapted from [7]).

	Availability level	Final Product (FP)	Logistics Chain Resources (LCR)
Execution mode	Real-Time (RT)	RT/FP	RT/LCR
	Batch Mode (BM)	BM/FP	BM/LCR

V. Conclusion

In an increasingly competitive environment, firms today must be able to respond quickly and correctly to the customer. In other words, they must be able to deliver customers on time, with "good products" and all this at the best cost. It requires new responses of industrial organization and logistics. Leagility has made it possible to decompartmentalize the supply chain within the company, generating substantial competitive advantages for those who have implemented it. In this context, we have shown first that the concept of leagility emanates from the coupling of lean and agile orientations. Indeed, the lean model is a characteristic of the SC that aims to minimize costs while agility is a characteristic of the DC whose objective is to provide responsiveness and effective response to Expectations of customers. The combination of the 2, i.e., integration of DC & SC, allows achieving leagile systems. The three determinants of performance corresponding to each of the three criteria that characterize the leagility. The latter then combines all the features that are efficiency, efficiency & responsiveness. This performance triptych is the three-dimensional frame of reference to which the key indicators relating to performance have also been determined. Also, the implementation of this referential suggests the need to equip it with the AATP MB / TR approach (Advanced Available to Promise). This multi-criterion decision-making tool considers the governance problem associated with the various actors involved and makes it possible to find a compromise between the objectives of the SC and those of the DC (integration). It also shows certain flexibility by the possibility of substituting products, delivering several times, or using many distribution sites.

Furthermore, within the industrial world, different types of application of strategies can be defined depending on the customer's category and priority as well as the order type.

Finally, this full change requires time & force. It is time to do so without fear of challenging most of its achievements.

References

[1] R. Mason- Jones, JB. Naylor, DR. Towill, Engineering the leagile supply chain, International Journal of Agile Management Systems, Vol.2, pp.54-61, 2000.
[2] JB. Naylor, MM. Naim, D. Berry, Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain, International Journal of Production Economics, N°62, pp.107-118, 1999.
[3] A. Agarwal, R. Shankar, MK. Tiwari, Modeling the metrics of lean, agile, and leagile supply chain: an ANP-based approach, European Journal of Operational Research, Vol.173, pp.211-225, 2006.
[4] M.Christopher & DR. Towill, An integrated model for the design of agile supply chains, International Journal of Physical Distribution & Logistics Management, Vol.31, N°4, pp.235-246, 2001.
[5] P. Hines, M. Holweg, N. Rich, Learning to evolve: a review of the contemporary lean thinking, International Journal of Production and Management, Vol.24, N° 10, pp.994-1011, 2004.
[6] U. Okongwu & al., Trade-off in order management: a Multicriteria Advanced Available To Promise approach, Academy of Management annual meeting the USA, 2008.
[7] R. Pibernik, Advanced Available To Promise: Classification, selected methods, and requirements for operations and inventory management, International Journal of Production Economics, Vol.93-94, pp.239-252, 2005.