Implementation and Cybernetic Control of Legrile Manufacturing Paradigm

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Abstract
Developing sustainable approaches to manufacturing is a critical global concern. Environmental and competitive processes are changing the global and manufacturing environment. Key measures to-ward this includes improving manufacturing efficiency and effectiveness. Legrile manufacturing is a process of integrating the concept and philosophy of lean, green and agile using a cybernetic/ recursive working model.
This paper is directed to the relevance of cybernetics for effective management of legrile manufacturing system/strategy. This aspect opens greater opportunity for scientific and logical investigations. After giving a brief introduction to legrile manufacturing system, the paper describes procedure for effective implementation and a metasystemic working model along with concept of feedback and transfer functions.

Keywords
Legrile, Cybernetics, Recursive, Meta-Systemic, Feedback

I. Introduction

In recent years programmes intended to develop effective lean, green & agile manufacturing systems [1-5] and have been implemented in many of the world's leading companies. Many have been highly successful for increasing efficiency, reducing costs, improving customer's response time and contributing to improved quality & greater profitability. Several researchers efforts discussed in the literature indicate that lean companies show significant environmental improvements by being more resource and energy efficient. Some studies [6-8] also show how lean, green & agile systems share many of the same common practices to reduce their respective wastes.
A model that integrates the three i.e. lean, green and agile into the comprehensive programme [9] focused on reduction of all wastes, intelligent, flexible and adaptive, can be a most effective and efficient path to a long term sustainable legrile manufacturing system. This aspect opens greater opportunity for scientific and logical investigations.
This paper concentrates on the concept of legrile manufacturing system and the procedure to be used for implementation of legrile manufacturing paradigm. It also explains cybernetic/recursive working model that integrates the three i.e. lean, green and agile.
It is imperative that efforts by the various organizations' small or big towards the sustainable legrile manufacturing should compliment to each other to minimize the duplication. Furthermore policy makers should play greater role in developing and implementing policies and procedures to support legrile manufacturing development approaches, simultaneously throughout the country in a coordinative and proactive manner. For anyone involved in ligrile manufacturing, this timely paper offers a road map to the mechanisms used in design, development and implementation of this complex system.

II. Legrile Manufacturing & system Integration

This marriage of lean manufacturing, green manufacturing and agile manufacturing systems lead to what can be viewed as legrile manufacturing, Fig1, which spans a spectrum of complexity both in terms of its physical structure and manufacturing task it performs. In practice it is highly probable that information technology and physical means of integrating should be considered in attempting to gain maximum benefits from synergism.

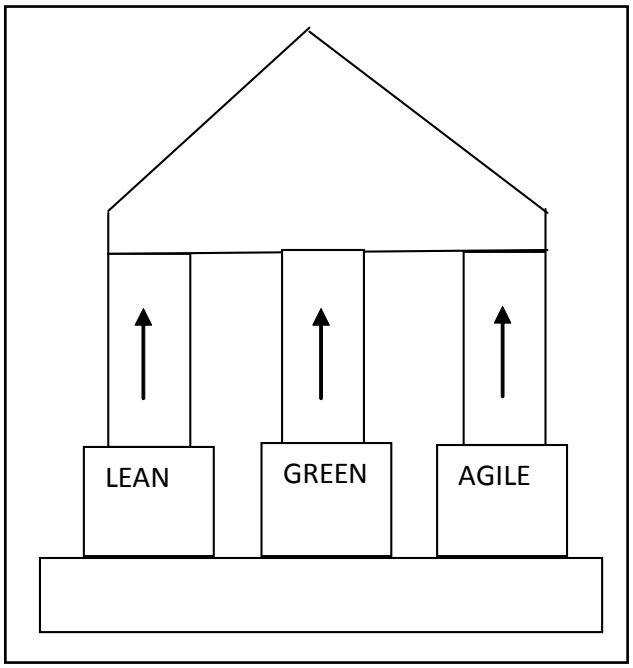

Fig. 1: Legrile Manufacturing System

In the area of legrile system/strategy it is important to focus on emerging integrated technology methods, tools and standards which can support operation of legrile manufacturing. Such mechanism has been developed as a mixture of integration infrastructure and integration process mechanism, fig. 2.

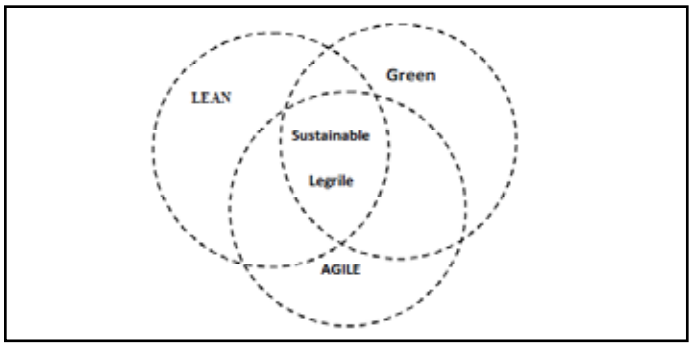

Fig. 2: Legrile Manufactring System Integration

3. Legrile Manufacturing Implementation in Companies

In the case of moderate companies, the employees are not very enthusiastic to accept legrile manufacturing paradigm.

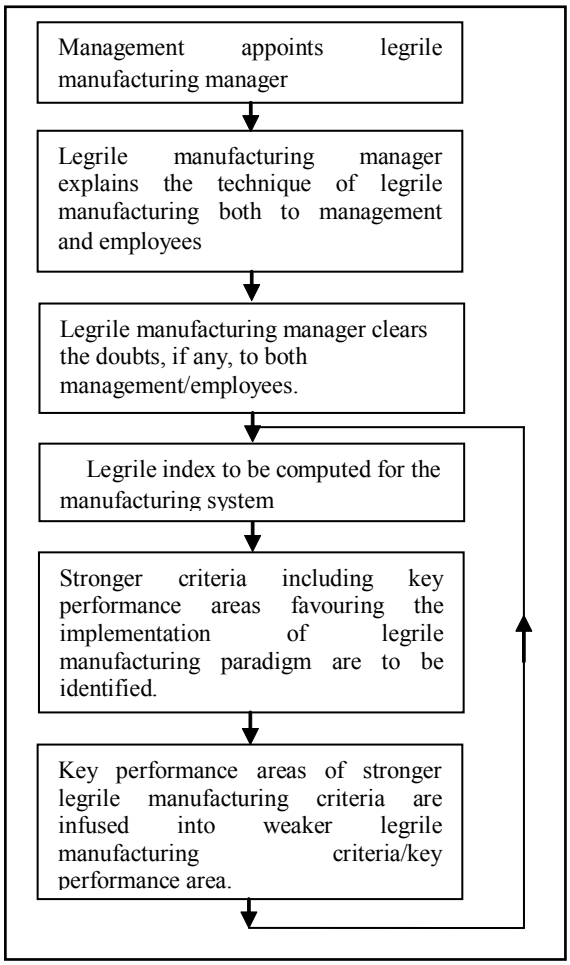

Fig. 3: Legrile Manufacturing Implementation Procedure

This may be due to various reasons such as fear of encountering heavy workload, chance of losing professional upliftment and hesitation and incompetency to learn theory, knowledge and practice. In order to overcome this threat, legrile manufacturing paradigm should be systematically implemented. The procedure to be used for accomplishing this task shown in the fig.3.

In order to meet the impact of globalization of products and manufacturing under legrile system it is necessary to consider the following.

- Supply of customer oriented products.
- Challenges posed by multinational companies which are already processing different competitive manufacturing techniques.
- Need to produce components and products of international standard in terms of quality and cost.
- Healthy environment and enhancement of work force.
- Energy conservation, environmental friendly products.
- Use of eco-friendly material, manufacturing processes.
- Implementation of eco-friendly manufacturing processes.
- Eco-friendly aspects during manufacturing, use and disposal of waste.
- Flexible and adaptable manufacturing system.

IV. Cybernetic/Recursive Working Model

If viable system contains a viable system, then the working system must be recursive.

The stereotype of working model of the system that has frozen out of history in a vertical hierarchical structure looking like a family tree with cousin increasing down the hierarchy, basically operates through delegation and a linear chain of command. Such system is competent to handle vertical relations, but fails to deal effectively with horizontal interactions. A Technological and strategic revolution that has produced change in the rate of change, the society has grown awfully complex and has become massively interactive. That is why the traditional type of working model does not work, the reason of its failure being inability to take care of the horizontal interactions which are also recognized pertinent for this type of model.

The usual way to respond to this new problem has been encumber the organization stereotype with cross fertilizing mechanism such as inter department community, task groups, liaison community, national commission and so on.

They have all been conspicuous only their failure; but the stereotype working model of system does not acknowledge such things.

To overcome this fig. 4 shows a cybernetic/recursive working model. The thing worth noted is the essential metasystemic character of the five tier hierarchy together with the powerful metalogical circumstances that the working model of each operating division of the whole is a micro-cosmos of the total working model.

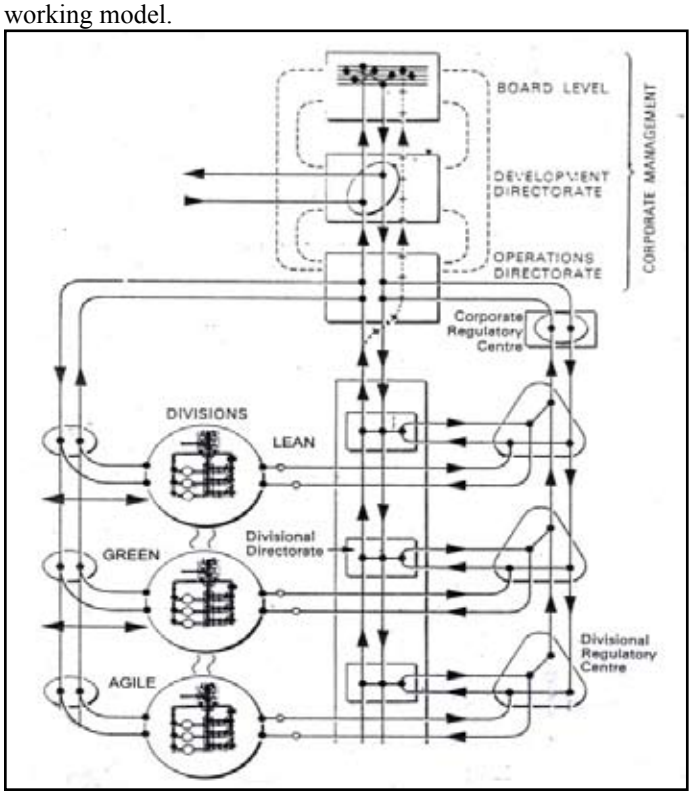

Fig. 4: Cybernetic/Recursive Model of Legrile Manufacturing System

It has been stressed passim here that the whole is always encapsulated in each part and that this is lesson learned from biology where we find the genetic blue print of the whole organization in every cell. This means that in figure4, the whole of working model is reproduced within each circle representing a division/sub-system, and of course this means in-turn that the whole working model would be reproduced in each sub-system of each sub-system, if we could write or read that small which is to say in each little circle with in every big circle and so on indefinitely. Further when we know the system which is supposed and imagine the whole of the system reproduced once again to a size which will be too big to fill the room even. It is this recursive characteristics in which make this working model a competent model for this legrile manufacturing. Cybernetic has learned that the trick in theory from formal logic and in practice from genetics.

V. Feed Back System of Legrile Manufacturing Paradigm

The block diagram fig. 5 is a short-hand symbol of a physical system of legrile manufacturing which pictorially represent the system. It is analytic model of close loop type where the control action is dependent upon the system output.

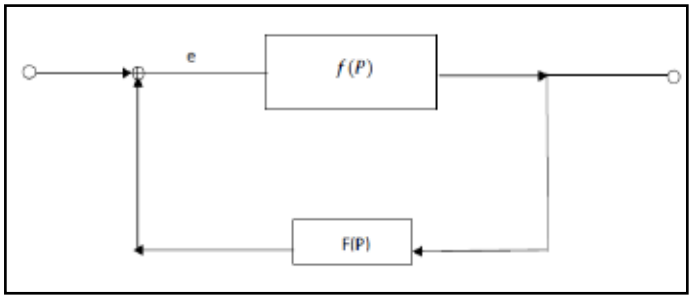

Fig. 5: Analytic Model of Feedback for LMP

This measures the actual system output compares it with the input and determine the deviation which is then used for controlling the system output to have the desired results. It is clear that for strategic decisions "feedback" is important. The term"feedback" means to cybernetic thinking that its connotations should be unraveled with some care. Fig. 5. clearly shows a system has input and it has output. What goes on inside the system that turns the first into the second, this is called a transfer function. It means the rate of change of the input – output relation with respect to the time. The operator in this transaction may be denoted by 'P'.

This means $f(P) = \frac{O}{i}$, where 'i' is the input variable and 'O' is the output variable. When the input is steady the transfer function produces a steady output which is exactly right. If the input begins to change in regular way, the output also has to be like that. Whatever happens, at any rate, it is possible to measure the continuous change in the output variable, and to compare it with what it is suppose to be. This measurement which may itself has to undergo some modification; it is "feedback" to adjust the input so that existing transfer function determines a correct output. Feedback has its own transfer function which may be written as F (P). The input to the feedback is the output 'O'. The output of the feedback network is a modification of this value. After the feedback transfer function has been applied which is: O.F(P)

e=i+O.F(P)

O=e.f(P)

O={i+O.F(P) }f(P)

O=i.f(P)+O.F(P).f(P)

O{1-F(P).f(P)}=i.f(P)

$$\frac{O}{i} = \frac{f(P)}{1 \pm F(P).f(P)}$$

It is evident from the above equation, how feedback becomes either positive or negative. Consider the term which multiplies the forward and feedback transfer functions by each other for example F(P).f(P). For no correction at all, this value would be '0' and transfer function would work out correctly as f(P) itself. If the multiplicative value is larger than 0, the denominator will be less than unity, and the value of the total function will be greater than the forward function alone – positive feedback. If the multiplicative value is less than 0 the denominator will be greater than unity and the value of total function will be less than the forward function alone – negative feedback. Evidently, the same system will generate either negative or positive feedback, depending upon the form of variation affecting the input, and the face shift, involved in relating the two internal networks.

As the system differs from situation to situation interacting parameters may vary in significantly according to the size and the type of the legrile manufacturing system and hence transfer function of the system will change depending upon the situation. System input and output can be modified considering standard cost, profit, market conditions, size and shape of manufacturing/ system to suit its own requirement.

VI. A problem With Action Plans

A. Problems or Issues

How to make sound business decisions when confronted with a variety of sustainability factors.

B. Root Cause

Businesses are mainly concerned with profit, sales and market share. It is difficult to compare these factors among different drivers, industries and companies.

D. Recommendation

Develop a better understanding of the drivers and relationships among these factors.

E. Action Plans

Reduce costs by analyzing the life cycle of products, establishing a link between sustainability and financial performance.

Anticipate regulations and clearly identify the minimum requirement that satisfy compliance. Towards this end, it is expected that industry to be transparent and encourage sharing and cooperation.

Develop measurable indices, which can be represented in monitory terms.

VII. Conclusion

Traditional manufacturing rapidly giving ways to new, fast response, and customer focused techniques that maximize the manufacturing return on resources- capital, materials, equipments, facilities, personal and most important time. Farsighted manufacturer to-day are implementing cultural changes throughout their organization that complement technological advancements and facilitate the transition from mass to flexible, to lean, to green, to agile, to leagile and to legrile sustainable manufacturing techniques. Individual contributions is giving way to self managed and to self directed employs teams utilizing empowerment to manage day to day floor activities and resolve production issues.Our intent for writing this paper is to attain the capabilities of specified effectiveness by integrating three different manufacturing strategies i.e. lean, green and agile as legrile manufacturing system.The designed recursive model along with a system equation for its solution is represented considering input, forward transfer function, output and feedback transfer function. But the designed model can be more complex and varied in its attack or it can be made very simple but it should be compressive and well integrated so that each part re-enforce the other part as well as adding effectiveness to the whole model. The effectiveness of the system depends on the sincerity of the management interest in it and support given to it; on how well it has been investigated to meet the real legrile needs of the manufacturing industry and its objectives in its implementation.

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