

ROADMAP FOR THE IMPLEMENTATION OF LEAN PRODUCTION SYSTEMS

Uwe Dombrowski, Thimo Zahn, Tim Mielke

IFU Institute of Production Management and Enterprise Research, Technische Universität Braunschweig,
Langer Kamp 19, 38106 Braunschweig, Germany

Abstract

In today's business environment many enterprises implement **Lean Production Systems (LPS)**. Although the basic configurations and structures as well as the elements of an LPS are known, often the expected positive effects or the improvements of the processes do not occur. A root cause for missing positive effects is an inadequate planning of the LPS implementation process. The high complexity of LPS and the long implementation period are impeding the overview over all tasks in LPS implementation. Without a sufficient overview a goal-oriented planning is barely possible. Hence the goal of this paper is to develop a roadmap for the LPS implementation. The roadmap contains the description of the tasks during the LPS implementation allocated with the phases and steps of the implementation. The roadmap helps enterprises to make an adequate planning and by that to avoid failures during the LPS implementation.

Keywords:

Lean Production Systems, Roadmap, Implementation Process

1 INTRODUCTION

Current trends on the global markets such as customers' demand for higher quality, shorter product life cycles, shorter delivery times and lower costs lead to the fact that enterprises cope with these changes by implementing Lean Production Systems [1]. According to Dombrowski an LPS is defined as an enterprise-specific compilation of rules, standards, methods and tools, as well as the appropriate underlying philosophy and culture for the comprehensive and sustainable design of production. The goal is to meet the requirements of today's business environment, taking into account organizational, work-force-related and economic aspects [2].

According to a structural analysis of different Lean Production Systems, LPS have general goals which directly address the customers' demands. These general goals are separated into sub goals, which are assigned to the different fields of activities. Each field of activity consists of several methods and tools, which are used to attain the sub goals. [3]

Despite the knowledge about the LPS fields of activities, methods and tools as well as the knowledge about the basic interrelation of the LPS elements, the positive effects often fall behind the enterprises expectations. Among other issues a cause for this is an inadequate planning process of the LPS implementation [4], due to the immense complexity and the long implementation process (5-10 years) [5].

To cope with this problem different implementation process models exist in literature, which describe the general approach and several implementation tasks, which are necessary for an LPS implementation. Those implementation process models do not deliver a systematic description of the tasks which have to be taken into account during the planning of the LPS implementation. An overview of the necessary tasks during the implementation that enables enterprises to perform a sustainable and effective planning process does not exist so far. Thus, the goal of this paper is to present a roadmap for the implementation of LPS. In this context the roadmap represents a systematic and complete schedule which describes the required tasks for implementation in chronological order. The roadmap supports enterprises

during their lean transition by assigning the tasks to the steps of the implementation according to the LPS Implementation Process Model. The presented roadmap describes a general approach for a successful LPS implementation which certainly needs to be adapted for each application.

To deduce and assign the tasks to the steps of the Implementation Process Model, the process itself is described in the first section of this paper. Therefore the Implementation Process Model according to Dombrowski is taken as a reference framework [3]. In the second section, the roadmap is developed by assigning the necessary tasks to the steps of the Implementation Process Model. The tasks have been identified by analyzing the process models according to Korge/Spath, Baumgärtner, Oeltjenbruns, REFA and the Massachusetts Institute of Technology (MIT) [6], [7], [8], [9], [5], [10]. The identified tasks have subsequently been allocated into the Implementation Process Model. The allocation was carried out according to the mentioned process models, literature researches and interviews with LPS experts.

2 INTRODUCTION OF THE PHASES AND STEPS OF THE LPS IMPLEMENTATION

The LPS Implementation Process Model (Figure 1) is divided into nine steps which are clustered in four phases.

The implementation process starts with the centralized Basic Planning phase. The first step of the implementation process is Awareness (step 1). Typically, a member of senior management learns about success stories of existing LPS. If this top-level manager decides to pursue the idea of an LPS, the expected benefits with such a system are analyzed and the interaction of the lean principles with the existing production strategy is checked (step 2). In the step of Lean Assessment it is necessary to develop enterprise-specific LPS goals. The assessment step ends with the senior management's decision whether to commit to the LPS or to abandon the idea. In the third step a central LPS planning team and a central steering committee are installed. The task for the planning team is to develop the Conceptual Design. Once the Conceptual Design is agreed, the planning team devises a master plan for implementation across different production sites (step

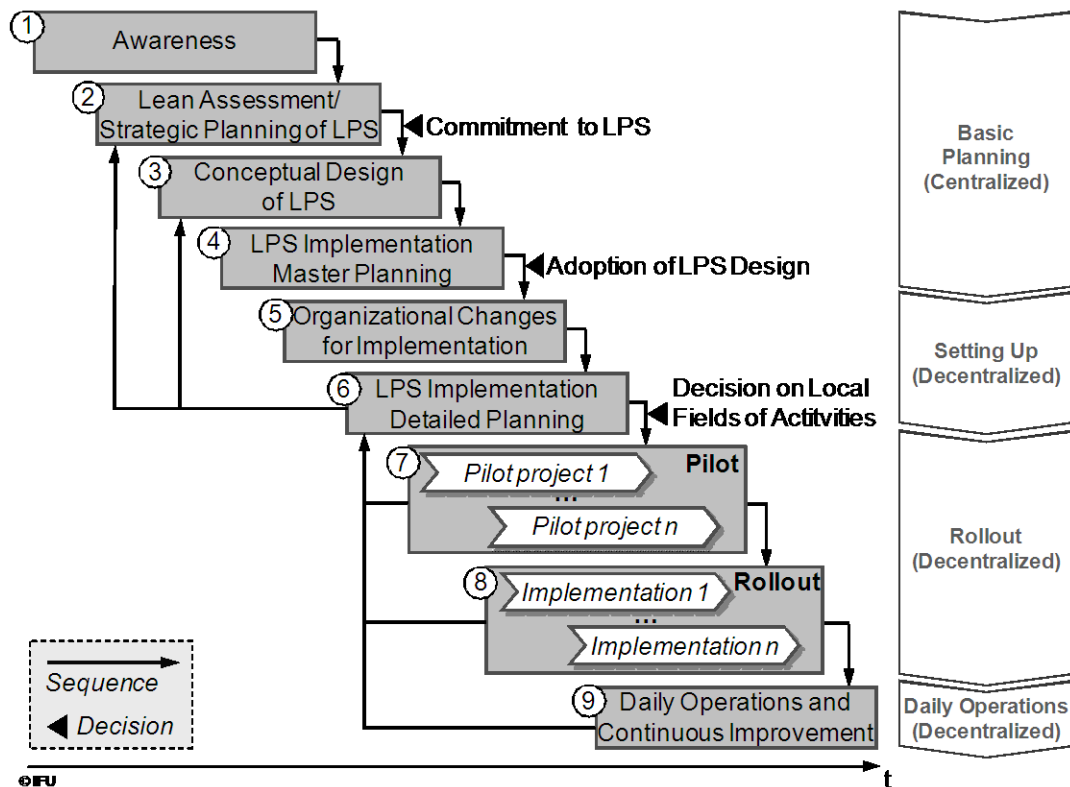


Figure 1 : Phases and steps of the IFU Implementation Process Model [3]

4). At the end of the Basic Planning phase the LPS design and the implementation master plan are adopted. [3], [4]

The centralized Basic Planning phase is followed by the decentralized Setting Up phase which starts with the step of Organizational Changes. At the different production sites decentralized planning teams and steering committees are installed on different levels in the organization (step 5). These decentralized planning teams develop detailed implementation plans (step 6). The decision on local fields of activities marks the end of the decentralized Setting Up phase. [3], [4]

The next phase is the decentralized Rollout phase. Depending on the chosen implementation strategy a pilot project can be applied in a defined division (step 7). Afterwards the LPS rollout, in which methods and tools are introduced and applied, follows in step 8. [3], [4]

After the transition to the decentralized Daily Operations phase the implemented elements have to be applied and developed further in order to ensure continuous improvement. Existing methods, tools, rules or standards have to be readjusted permanently. Therefore it is possible to return to the previous detailed planning. If fundamental changes are required even a redesign of the LPS concept or a return from the detailed planning to the conceptual design or the strategic planning of LPS may occur. [3], [4]

3 ASSIGNMENT AND SUMMARY OF THE LPS IMPLEMENTATION TASKS

In the second section the tasks will be assigned to the described phases and steps of the LPS implementation process. The roadmap is shown in figures 2 to 5.

Awareness: As described in the first section, the implementation process typically begins when top management finds out about success stories of existing LPS. The tasks within the first step concern mainly the understanding of the structures and complexity of an LPS and the need for action and change. Top managements understanding about the general structure is an important

precondition to ensure an appropriate decision-making during the implementation period and the following Daily Operations phase.

Lean Assessment/Strategic Planning of LPS: In this step, top management deliberates about whether an LPS should be implemented and how the lean principles interact with existing production strategies. Therefore the advantages of such a system and the current state of the existing processes are analyzed. Involving LPS experts in this early stage of the implementation can be beneficial.

In order to evaluate the enterprises business environment, analyses of markets, competitors and customers as well as benchmarks have to be carried out. Furthermore the internal processes need to be reviewed closely, if necessary in cooperation with external consultants.

Since LPS generally consist of several fields of activities, methods and tools, the existing rules, standards, methods and tools have to be reviewed closely and replaced as necessary.

Before an LPS can be drafted, a vision and mission for the enterprise needs to be devised. The vision is the initial point, from where the entire business strategy, general goals and sub goals are being deduced. Furthermore, the LPS goals and a performance measurement system for the LPS key performance indicators (KPI) should be developed. In order to ensure the strategic success of LPS, the goals and the KPI should be aligned with the general goals of the enterprise [9].

Finally top management decides whether to continue or to cancel the implementation of the LPS [3]. Important stakeholders should be involved in this decision.

If the decision is to continue the LPS implementation, top management must set a good example for the middle and lower management as well as it is responsible to ensure the communication in order to achieve the necessary attention and support by the employees. Top management has to be committed to the LPS otherwise a successful implementation is barely possible. With the commitment to

the LPS, the top management should name the persons who are in charge for further planning tasks and who constitute the central planning team.

Conceptual Design of LPS: In the beginning of the new phase, the central steering committee and the central planning team are installed as well as the evaluation of the current state of the LPS goals is started. In addition, the conceptual design, in which the structure of the LPS is determined, will be developed by the planning team.

Based on this structure sub goals and the respective fields of activities will be determined. Altogether, 14 fields of activities are widely-used in contemporary LPS, among them: Standardization, Pull Systems, Visual Management, People and Leadership, Continuous Improvement Process, Zero-Defect-Policy Continuous Flow and Waste Reduction. Each of these fields provides a framework for methods and tools of similar content. [11]

After the sub goals and fields of activities are chosen, the performance measurement system developed in step 2 can be expanded by adding KPI for the sub goals of the LPS. As for any performance measurement system, it is important to declare a target value for each KPI and to measure the current state.

If the structure and the LPS-elements are fixed, the implementation strategy needs to be developed. Characteristics of the implementation strategy are leadership-, object-, context- and time- dimensions.

- Within the **leadership dimension** a general management and leadership policy will be defined for the implementation. This policy should be already deployed during the design process of the LPS and is applicable for the whole process. Furthermore it will be determined if and how the employees will be involved in the decision-making. [11]
- The **object dimension** consists of two parts. On the one hand the question about the extent of the LPS will be answered („How many methods and tools have to be introduced at the same time?“) and on the other hand the object perfection will be determined. [11] Since the extent quantifies the object dimension of the LPS, the object perfection describes the qualitative dimension.

Depending on the complexity, all LPS-elements can be implemented simultaneously or in different stages. Precondition for the simultaneous introduction of all LPS-elements is that the correlation and contents of each LPS-element are well-known. A stepwise implementation of discrete LPS-elements is for example necessary when the elements are based on each other. [11]

When selecting the degree of object perfection it needs to be clarified if either an ideal or an approximate solution is preferred. The approximate solution determines a first concept which needs further adjustments. [11] In case of the LPS implementation an approximate solution with a continuous improvement is to prefer.

- The **context dimension** consists of the definition of the implementation scope and the changeover approach for the LPS. [11]

The implementation scope can include all affected departments. The implementation in all relevant areas and divisions (scope) according to the implementation plan can be carried out simultaneous. In contrast a successive implementation in smaller scopes with a fix implementation sequence is possible. [8]

- The fourth dimension of the implementation strategy is the **time dimension** in which the appropriate implementation dates are determined. Possible strategies in this dimension are for example the determination of the implementation date in consideration of the maturity level (utilizability) of the LPS-elements or in regard to other circumstances that offer good opportunities for an implementation. [11]

As well as the determination of the implementation strategy, a cost-benefit-analysis is useful to evaluate the economic efficiency of the LPS. In this case a long-term estimation is necessary because the efforts tend to occur primarily at the first three phases of the LPS implementation process, whereas the benefits occur primarily in the Daily Operations phase.

In addition the implementation organization has to be chosen. This includes the decision, which tasks will be executed by which functions and with which resources. The organizational framework for the implementation strongly depends on the implementation strategy.

Furthermore it is important to involve the shop committee in the planning process. Thus possible disagreement can be avoided at an early stage. [4]

LPS Implementation/Master Planning: Based on the conceptual design a master plan will be developed. The master plan fixes the dates, activities and responsibilities in the implementation process [5], [10].

In addition a communication and feedback system has to be installed and a qualification concept, in order to prepare the employees for the implementation has to be planned. In this context ex-cathedra teaching, cascade training or methods-champions-education are possible concepts for qualification. [6], [1]. Furthermore the promotion, human-resource, incentive and compensation systems should be checked to ensure their LPS suitability. If necessary the systems should be adjusted already in this step. Otherwise sub goals and fields of activities cannot be realized as planned [8]. For this reason, it is necessary to communicate the LPS goals and the implementation strategy to all participants who are involved in the implementation process.

As the last task of the centralized Basic Planning phase, the Conceptual LPS Design including all LPS elements, the chosen implementation strategy as well as the generated master plan should be authorized by the top management.

The four steps and the respective tasks of the Basic Planning phase are shown in figure 2.

Step		Tasks
1	Awareness	<ul style="list-style-type: none"> - Cognition of the advantages of LPS - Understand the structures of a Lean Production System - Top management has to act as the driving force
2	Lean Assessment / Strategic Planning of LPS	<ul style="list-style-type: none"> - Involve LPS experts - Analysis of markets, competitors and customers - Analysis of the own enterprise - Identification and revision of the existing rules, methods and tools within the enterprise - Develop and implement a vision and mission for the enterprise - Constitute a business strategy and set up goals for the enterprise - Deduction of LPS goals and key performance indicators (KPI) from the general goals - Identify and involve important stakeholder - Decision about the realization of LPS by the top management - Convey the importance of change to the middle and lower management
3	Conceptual Design of LPS	<ul style="list-style-type: none"> - Install a central steering committee and a central planning team - Evaluate the current state of the LPS goals - Develop the conceptual design (LPS structure) - Determine sub-goals as well as fields of activities of the LPS - Definition of methods and tools - Determine the KPI of the sub-goals, define the target values and measure the current state - Select an adequate implementation strategy - Conduct a cost-benefit-analysis to evaluate the economic efficiency - Choose the organizational structure for the implementation - Involve the shop committee
4	LPS Implementation / Master Planning	<ul style="list-style-type: none"> - Develop a master plan including dates, activities, relevant areas and responsibilities in the LPS implementation process - Install a communication and feedback system - Plan qualification concepts, trainings and instructions - Communicate the LPS goals and the implementation strategy to all participants of the implementation process (top-down approach) - Develop and install motivational systems (i.e. promotion, human resource, incentive and compensation systems) and link them with the LPS goals. - Authorization of the conceptual design and the master plan by the top management

Figure 2 : Roadmap of the LPS implementation – Phase 1 : Basic Planning

Organizational Changes for Implementation: The decentralized Setting Up phase begins with organizational changes regarding the implementation. Therefore local planning teams and steering committees will be installed by the central planning team. Every local planning team has to be equipped with the required information and qualification. Afterwards the local planning teams are responsible for the further decentralized planning (detailed planning) [3], [9]. To support the realization of the LPS, implementation teams who are responsible for the local preparation, adjustment, and final realization should be established. The implementation teams consist of members from the local planning team and shop floor workers whereas the local steering committees consist of members of the management (e.g. plant management) to supervise the implementation process.

In order to enhance the cooperation of the local planning team and the employees, supporting actions could be taken. To reduce the obstacles between management and shop floor workers, periodic interdepartmental meetings could be arranged and a „go to gemba” (go to the shop floor) routine should be established.

Moreover, an escalation management should be installed to avoid delays during the implementation. Customers as well as suppliers should participate during the Setting Up phase, in order to prevent barriers in further implementation. All of those organizational changes should be carried out during this step of implementation. From this step on, it is even more important that the top management sets a good example to the employees by showing an LPS oriented leadership behavior.

LPS Implementation / Detailed Planning: In this step the local planning teams develop detailed LPS implementation plans and strategies for the local realization, regarding the local contents and specifications [3]. To achieve these plans, the processes as well as product features and customer demands (also internal customers) have to be analyzed in detail [10]. Based on the detailed plans the assignment of financial, personnel and material resources as well as the authorization of them by the local steering, should be done.

In order to inform the employees about the implementation plans and the local implementation strategy, kick-off events

Step		Tasks
5	Organizational Changes for Implementation	<ul style="list-style-type: none"> - Install local planning teams and steering committees - Establish implementation teams including the shop floor employees - Remove the steric distance; plan periodic interdepartmental communication; implement a „go to gemba“ routine - Implement an escalation management - Inform and integrate customers and suppliers - Conduct organizational changes for the LPS implementation - Ensure, that top management sets a good example for the workforce
6	LPS Implementation Detailed Planning	<ul style="list-style-type: none"> - Analyze the processes as well as the product features and the customer demands (also internal customers) - Develop detailed LPS implementation plans (by the local planning teams) - Develop local implementation strategies based on the central strategy - Identify the demand for financial, personnel and material resources - Inform the employees about the local activities in their departments - Realize the developed qualification concept

Figure 3 : Roadmap of the LPS implementation – Phase 2 : Setting Up

should be conducted. Thereby the employees should have the opportunity to take responsibility and to influence the decisions concerning the implementation of methods and tools. Thereafter, the previously planned qualification concepts need to be carried out. Figure 3 refers to the decentralized Setting Up phase.

Pilot project: If the top management decides based on the context dimension of the implementation strategy, to begin with the implementation in a small scope, the realization of a pilot project is the first step of the Setting Up phase.

Depending on the implementation strategy parts of the LPS will be implemented in the pilot scope in order to demonstrate and to identify the interdependencies and the mutual support of the methods and tools as soon as possible. Additionally supporting activities like management games should be applied, since they help to experience the practical use and support the understanding.

In order to benefit from the experiences of the pilot projects, a comprehensive documentation concept is necessary.

Rollout: Within this step, the experiences made during the pilot project, should be adapted for all other implementa-

tion areas. With the start of the rollout, a kick-off event with all involved departments and teams should be carried out. In the event, commitments and standards obligatory for the whole management (e.g. a „no-blame“-culture) will be introduced and presented.

Since problems, barriers and misunderstandings often occur at the beginning of the rollout, small teams should be established in the shop floor. In these teams, the operative management is promoting the problem-solving process.

Within this step, the responsibility for the implementation of the LPS is delegated to the shop floor.

Furthermore the rollout is attended by a comprehensive communication in order to support and adjust the progress of the implementation if necessary. The comprehensive communication contains information boards as well as KPI to inform management and shop floor workers about the progress of the implementation. The information should be provided on the shop floor to support the “go to gemba” routine. Especially KPI should be documented and controlled during the whole progress. Both steps of the decentralized Rollout phase are summarized in figure 4.

Daily Operations/Continuous Improvement: Because the implementation of the LPS is a continuous process, the

Step		Tasks
7	Pilot	<ul style="list-style-type: none"> - Realization of pilot projects - Train methods and tools in management games - Introduce a comprehensive documentation system
8	Rollout	<ul style="list-style-type: none"> - Apply the conclusions from the pilot project to the other departments - Hold kick-off events - Introduce commitments and standards for the management - Define standards - Ensure comprehensive communication / establish a „no-blame“ culture - Documentation and controlling of the LPS key performance indicators - Delegate the responsibility for the realization to the shop-floor - Establish small teams in the shop-floor to pursue the problem-solving-process - Inform top management about the progress - Show progress to all employees (e.g. information boards)

Figure 4 : Roadmap of the implementation – Phase 3 : Rollout

Step		Tasks
9	Daily Operations / Continuous Improvement	<ul style="list-style-type: none"> - Initiate continuous improvement activities, establish constant communication, build a basic routine for the change process - Complete documentation of the implementation process and the LPS itself - Execution of audits - Documentation and controlling of the LPS-specific KPI/ evaluate the progress of implementation - Realize benchmarking and best-practice-exchanges - Sustain and develop processes - Ensure that the management keeps the commitments and standards - Increase customer orientation, implement a supplier development - Check the application of "lean-principles" to not considered departments and the supply chain

Figure 5 : Roadmap of the LPS implementation – Phase 4 : Daily Operations

transition from the Rollout to the Daily Operations phase is fluent. In the Daily Operations phase the efficiency and effectiveness of the implemented LPS elements have to be ensured by audits and controlling of LPS-specific KPI. The controlling provides the basis for the continuous improvement of the production system [6], [5].

Besides audits and KPI benchmarking, best-practice-concepts can be compared and implemented. For a sustainable application of the LPS, a complete documentation of the current processes needs to be assured.

Besides the daily operations, all processes have to be improved continuously. Goals, fields of activities, methods, tools and existing standards have to be questioned and enhanced permanently in terms of the continuous improvement [3].

The change process as well as the communication and documentation systems has to be implemented in-depth in the enterprise processes.

Additionally the customer orientation as well as supplier development should be enforced and the possible extension of the "lean principles" should be checked for so far not considered departments and the supply chain. All tasks of the Daily Operations phase are shown in figure 5.

4 CONCLUSION

Due to the immense planning complexity and the long implementation process of an LPS, a systematic description of all the tasks which have to be taken into account during the LPS implementation is necessary to assure an adequate planning. The goal of this paper was to present a roadmap for the implementation of LPS. The roadmap provides a systematic and complete schedule for the relevant tasks depending on the implementation phases and steps. For this goal the phases and steps of the Implementation Process Model were presented and the respective tasks were brought together in a roadmap. This roadmap makes a contribution to conduct a sustainable and effective planning and to avoid planning mistakes, which endanger the success of an LPS implementation.

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