

# Line of Balance Scheduling: Software Enabled Use in the U.S. Construction Industry

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The construction industry has been relying on the Critical Path Method scheduling technique (CPM) to plan and manage most construction projects. Numerous researchers have shown how the Line of Balance scheduling technique (LOB) has various intrinsic advantages, and offers solutions to many scheduling related problems, relative to the CPM scheduling technique. Studies show that a major reason the construction industry has been slow to adopt LOB scheduling was the lack of supporting software. With advancements in construction related technologies, theories, and ideas, the need for more effective and efficient scheduling and management tools has grown correspondingly. A review of literature and search for available software programs reveals very few attempts to produce a well-supported, advanced, and user-friendly LOB scheduling software program for the construction industry prior to the introduction of Vico Control®. With the availability of a supporting software program and the increasing needs and technological advancements in the construction industry, the industry could possibly experience a shift in the scheduling techniques currently used. This study will try to explore the effect of introducing software programs on the utilization of LOB scheduling, and evaluate the advantages, benefits, limitations, and implications of applying this scheduling technique in the construction industry through LOB software programs.

**Key Words:** Scheduling Software Programs, Line of Balance, Critical Path Method, Building Information Modeling.

## Introduction

The construction industry currently utilizes the Critical Path Method scheduling technique (CPM) to plan and manage most construction projects. This phenomenon is depicted in a study conducted by Tavakoli and Riachi in 1990. In their study, they surveyed the use of CPM scheduling in the top ENR 400 contractors. They found that 93% of the responding firms were utilizing CPM as their primary scheduling technique for their projects. Mattila and Abraham(1998) cite this statistic and comment “This high percentage of use would seem to indicate that the construction industry is satisfied with CPM as a planning and scheduling tool. However, a survey of members of the Associated General Contractors of America identified scheduling technology as the most important area requiring improvement (associated General Contractors of America 1993).”

For the past three decades, numerous researchers have identified the various intrinsic advantages of the Line of Balance scheduling technique (LOB) in comparison to the CPM (Chrzanowski & Johnston, 1986) (Spencer & Lewis, 2005) (Yamin & Harmenlink, 2001) (Jongeling & Olofsson , 2007) (Trofin, 2004) (Arditi et al. 2002). Literature shows that LOB schedules are better understood and more easily updated, facilitate better resource optimization, provide improved visual management, and are more capable in scheduling construction projects with a repetitive nature.

Studies show a major reason the construction industry has been slow to adopt LOB scheduling was the lack of supporting software. In their study, Jogeling and Olofsson (2007) explain their advocacy of LOB scheduling and claim that the technique has not been widely adopted in the construction industry “mainly due to the strong tradition

of activity-based planning and the absence of software packages that support location-based planning.” (Jongeling & Olofsson, 2007).

Research shows that, not only does LOB scheduling have intrinsic benefits in its concepts, but it also aids the implementation of new technologies and theories. For example, research explains how applying LOB scheduling could support and compliment Building Information Modeling technologies. Line of Balance scheduling is a location-based scheduling technique. When compared to the activity-based CPM, LOB provides a more practical scheduling method in implementing Building Information Modeling technologies. Jongeling and Olofsson (2007) state in their research that “location-based scheduling provides a promising alternative to activity-based planning approaches for planning of work-flow with 4D CAD. A location-based approach to 4D CAD could also improve the usability of the 4D CAD models for work-flow analyses.”

Prior to the introduction of the Vico Control® scheduling software, a well supported, advanced, and user friendly LOB scheduling program was not available to the construction industry. With the availability of the Vico Control® software and the increasing needs and technological advancements, the construction industry could possibly experience a shift in scheduling techniques. Some scheduling practitioners have begun using the Vico Control® software and implement LOB scheduling on construction projects. This paper reports the findings of a study which explored the utilization of LOB scheduling on construction projects along with benefits, limitations and implications of applying this scheduling technique. The study was performed through a series of interviews conducted with Line of Balance scheduling practitioners and experts.

## **Research**

The research included an extensive review of Line of Balance (LOB) scheduling, Building Information Modeling (BIM), 4D Modeling and other related literature. The authors investigated the impact of introducing software programs on the trends of use, and exploitation of advantages, of LOB scheduling within the construction industry. A series of interviews were conducted with five LOB scheduling practitioners using the Vico Control® software program (phase 1), an academician and a Vico Software company representative (phase 2). The scheduling practitioners were identified through the Vico software company, at the time the study was conducted (Summer 2008), they were among the few who purchased and started implementing Vico Control® in their firms. Each of the five practitioners interviewed has utilized the software program on a single project, for periods ranging from 5 to 12 months. The projects’ sizes varied from \$100 million to \$500 million projects. In most of these cases, the scheduling practitioners had existing CPM schedules and were utilizing Vico Control for analyses and resource management purposes as a transitional phase before the full implementation of LOB scheduling. The Vico Control® scheduling software was introduced to the market only a few years ago. To date, only a small number of firms have applied LOB scheduling and the Vico Control® software program in their organizations. Consequently, the scheduling practitioners interviewed have only used LOB scheduling and Vico Control® for a relatively short time and on few projects. Their experience with LOB scheduling is limited compared to their knowledge of the Critical Path Method.

Throughout this paper, the terms Line of Balance (LOB) scheduling and Linear Scheduling Method (LSM) are used interchangeably. There is a difference between the two terms; however they both fall under the category of location-based scheduling. The difference between LOB and LSM is explained by Arditi & Tokdemir & Suh (2001), they state that “Any differentiation between Linear Scheduling and the Line-of-Balance (LOB) technique is only a question of emphasis. In LSM, the emphasis is on the graph of time and space, which is similar to the progress chart in LOB. In LOB, the emphasis is on the progress chart and the balance Line. (Mattila & Abraham, 1998)” For the purpose and aims of the research, the difference between the two terms was seen to be relatively minor and negligible.

## **Review of Literature**

Jongeling and Olofsson (2007) defined Line-of-Balance (LOB) scheduling as “a visual scheduling technique that allows the planner to explicitly account for flow of a project. Line of Balance uses lines in diagrams to represent

different types of work performed by various construction crews that work on specific locations in a project.” They explained the first step to generate a LOB schedule is to break down the project in physical sections. For example, a project could be broken down and identified in terms of different locations, zones, sections, or floors. Afterwards, tasks (represented by lines) are created in the schedule by using items from the bill of quantities (bill of materials) or cost estimate in a project. Jongeling and Olofsson (2007) provide an example of this process. They state:

From the bill of quantity item ‘concrete floor 1’ the following tasks are derived: ‘install shoring’, ‘install formwork’, ‘install reinforcement’, ‘pour concrete’ and ‘remove formwork and shoring’. In this way a specification is directly made for the amount of work per location in a project for a construction crew. Based on these quantities and task descriptions, the required crew size can be determined. The bill of quantity items and cost estimate define what should be done and the tasks in the Line-of-Balance schedule define how this is done. This relation is often not explicitly made in CPM schedules and when done it leads to very detailed and unmanageable schedules.

Literature shows that throughout time, construction planners have found great success in applying LOB scheduling for projects with repetitive characteristics. Linear Scheduling Method (LSM) is best applied to projects like pipelines, highways, railroads, and utility projects. Spencer and Lewis (2005) explained planning and scheduling these types of projects is difficult using the Critical Path Method (CPM). Linear Scheduling is composed of continuous activities, unlike CPM which is composed of discrete activities. Furthermore, LSM schedules are based upon resource and jobsite location availability. This allows for improved resource management in construction projects. (Spencer & Lewis, 2005).

The advantages for using LSM have been realized and established for many years. Chrzanowski and Johnston in 1986 identified a number of benefits of LSM in their research. They affirmed the most obvious attribute of LSM is its simplicity. The LSM diagrams easily convey detailed information comparable to what may be derived from an equivalent CPM schedule. Additionally, with LSM, personnel can perform various types of project analyses with little training. (Chrzanowski & Johnston, 1986).

Chrzanowski and Johnston (1986) showed how LSM allows schedule updates, changes in job progress, and resource allocations to be performed quickly and with minimal difficulty, relative to the more commonly used CPM scheduling. Simplicity and clarity of the whole schedule are major advantages of LSM. The authors claim, after some study of the schedule, the user should be able to understand the flow of work through the project. The user could also comprehend the reasoning for performing the work in the illustrated sequence. (Chrzanowski & Johnston, 1986).

An article titled “Benefits of Linear Scheduling,” written by Spencer and Lewis (2005), discusses and summarizes advantages of using LSM. They claim that an LSM schedule allows for a critical or controlling path to be calculated. Furthermore, earned value analysis can be conducted and identified from the schedule. Schedule delays due to resource productivity, and delay due to weather and site conditions, can also be reasonably predicted.

Over the years, the construction industry practitioners have identified certain scheduling techniques for different types of projects. Some scheduling techniques are believed to be more suitable for certain types of projects. According to Yamin and Harmentink (2001) the Linear Scheduling Methods “perform optimally when scheduling linear continuous projects, such as highway construction. However, LSM can be very inefficient when scheduling complex discrete projects (bridges, buildings, etc.). The CPM is quite the opposite; it is ineffective and cumbersome for scheduling linear continuous projects but extremely efficient for more complex and discrete type projects.” Even though, the CPM is the technique used in scheduling the majority of construction projects, literature shows that it has a number of limitations and shortcomings. Akbas (2004) explains how the CPM technique is mainly useful for master scheduling.

The concept of finding a critical path is another major fundamental difference between LOB and CPM scheduling. Arditi, Tokdemir, and Suh (2001) explained how “In network analysis, at least one critical path exists. Activities which are on the critical path have to be started and completed by their assigned times if the total project duration is not to be extended.” The LOB scheduling methods’ criticalness is based on time and resources, unlike network scheduling where it is only based on time. As a result of the different rates of production of individual activities, critical activities in the unit network may or may not coincide with the critical activities in the LOB schedule. (Arditi et al., 2001).

Research shows that LOB scheduling is relatively more efficient, when compared to CPM, in scheduling construction projects that are repetitive in nature. “CPM based techniques have been criticized widely in the literature for their inability to model repetitive projects (Selinger, 1980; Reda, 1990; and Russell and Wong, 1993).” (as cited in Arditi et al., 2002). Arditi, Sikangwan, and Tokdemir (2002) also discuss the size of the network of a CPM schedule for a project with many repetitive activities. They state that “In a repetitive project of n units, the network prepared for one unit has to be repeated n times and linked to the others; this results in a huge network that is difficult to manage. This may cause difficulties in communication among the members of the construction management team.” (Arditi et al., 2002). Furthermore, the authors explain how CPM scheduling is designed for optimizing project duration rather than dealing adequately with the special resource constraints of repetitive projects. They claim that LOB scheduling have the capability to ensure a smooth procession of crews from unit to unit with minimal conflicts and decrease idle time for workers and equipment. Furthermore, it helps avoiding many hiring and procurement problems in issues pertaining to the flow of labor and material used during construction. (Arditi et al. 2002)

With advancements in the fields of Building Information Modeling (BIM) and Virtual Construction, the techniques and technologies used in scheduling construction projects have also evolved. The development of 4D Models has been one of the major advancements in the field of construction scheduling. “4D Modeling is a process/method in which 3D CAD models are visualized in a 4-dimensional environment.” (Jongeling & Olofsson, 2007). Typically, 4D CAD models are created by linking building components from 3D CAD models with activities extracted from a CPM schedule. One of the advantages of 4D modeling is that it provides the user with a clear and direct picture of the schedule. Akbas (2004) defines 4D Modeling as “4D CAD (or 4D) is a geometry-based construction process visualization technique (Koo and Fischer 2000). Its basic goal is the time-lapse visualization of a construction process by association of components and CPM schedule activities.” This visual representation of the schedule helps to quickly and clearly communicate this schedule to different stakeholders in a project. Simulating and analyzing what-if scenarios before commencing work on site is another useful advantage allowed by 4D modeling.

Activity based planning, like CPM scheduling has been the dominant scheduling technique for 4D Modeling. Jongeling and Olofsson (2007), claim there are numerous disadvantages to utilizing activity based planning for 4D Modelling. “Research and application of 4D CAD to date has been dominated by the linkage of 3D CAD building components with activity-based planning approaches, such as CPM schedules. The difficulty of applying flow-based thinking in such models arises from the problem that the models are based around discrete activities. An additional problem is the fact that 4D CAD models often are not organized according to a location-based logic, which further constrains the application of flow-based thinking.” Furthermore, in discussing 4D Modelling, Akbas (2004) state that because the basis of 4D Modeling is “on CPM networks and input 3D geometry limits its utilization for operations planning. It carries over some limitations of CPM; it assumes the production rate is constant for the duration of an activity, and it does not capture or visualize the reasons behind an existing plan or any geometric planning parameters, such as workflow directions.”

The research conducted by Jongeling & Olofsson (2007) investigates the association of location-based scheduling techniques and 4D CAD in detail, and present results from a case study where both methods are combined. Based on their study, they concluded that LOB scheduling offers solutions to various compatibility difficulties between 3D Cad models and construction project schedules. Furthermore, their study demonstrated how “location-based scheduling provides a promising alternative to activity-based planning approaches for planning of work-flow with 4D CAD. A location-based approach to 4D CAD could also improve the usability of the 4D CAD models for work-flow analyses.” Jongeling and Olofsson (2007) show how 4D Modeling and location based scheduling compliment each other and reinforce the various intrinsic benefits they possess individually. “The combination of location-based planning by applying the Line-of-Balance technique in combination with 4D CAD could be a promising method in which the strengths of both methods could reinforce each other.” (Jongeling & Olofsson, 2007)

## **Research Findings**

The interviewees were asked to comment, from their experience, about their level of satisfaction with using Line of Balance scheduling (LOB). Four of the five scheduling practitioners preferred LOB scheduling over CPM. Some of

them explained their preference by discussing how LOB scheduling allows the use of resource loading and setting quantities in producing the project schedule. When compared to the CPM scheduling technique, LOB allows for superior visualization of project schedules. Furthermore, the interviewees explained how the same project could be scheduled on relatively fewer pages using LOB. A scheduling practitioner stated:

*As a visualization tool, it is easier to read a Line of Balance schedule, once you understand how the lines go. Furthermore, as far as setup, for me, Line of Balance seems to be a much simpler way to schedule large amounts of activities, when compared to the Gantt chart schedule on a Primavera program. With a LOB schedule you don't have to replicate that activity every time. That decreases the amounts of pages needed for presentation of a certain sequence of repeated activities from 4 or 5 pages in a Gantt chart to just 1 page on a Line of Balance schedule.*

The interviewees also explained that because the activities are divided by location, the user is not required to schedule the same activity in all the zones and levels. They noted that this saves the time and effort employed in scheduling construction projects in general and projects with a repetitive nature in particular. One of the interviewees discussed how the clear incorporation of productivity rates in the scheduling process permits numerous benefits. However, he voiced his concern about the limitation of LOB scheduling to present a clear critical path of the project schedule. The Vico representative explained how LOB is superior than CPM in its higher compatibility with Building Information Modeling and 3D models.

All the scheduling practitioners interviewed agreed that they wouldn't have utilized LOB scheduling without the software program. One of the scheduling practitioners stated that the reason why he actually started utilizing LOB scheduling is because it is part of the whole Vico suite, namely Vico Constructor®. They all discussed how one of the main reasons LOB scheduling has not been applied more extensively in construction projects was the lack of LOB scheduling supporting software programs. One of the scheduling practitioners stated "Line of Balance scheduling has not been used more in the construction field, due to a lack of knowledge and awareness of the people scheduling, and the lack of existing software programs. Now with the existence of Control, more people could use and apply Line of Balance scheduling." Two of the interviewees predicted that with the availability of Vico Control®, a change in scheduling trends is possible, but will take time. Lack of education of LOB scheduling, in construction related education programs, is another major obstacle discussed by the interviewees. Furthermore, they predicted that Building Information Modeling technology will play a major role in the adoption of LOB scheduling in the future. Resistance to change of the construction industry was also one of the main hinderances mentioned by the interviewees. They explained it is very common for the industry to repel and refuse alternative ideas and technologies. The academician agreed with the scheduling practitioners that lack of education, unavailability of supporting software programs, and the construction industry resistance to change, are the main reasons behind the limited application of LOB scheduling in the construction industry. The academician elaborated on the problem pertaining to education, by providing an example from her experience as a university faculty member in a Construction Management program. She stated "To the best of my knowledge, we are still not teaching LOB scheduling to undergraduates. It seems like an advanced topic in academia and so we cover it in our graduate classes, we still focus on CPM scheduling because that is what the industry is using." However, the academician argued that with the increase in costs of labor and materials, it is becoming more crucial to utilize Line of Balance scheduling in the construction industry. The Vico representative explained how the Primavera scheduling software is currently dominating the construction industry because it existed in the market for a longer time (40 years), and it is taught in most construction related education programs.

All the interviewees agreed that LOB scheduling is superior to the CPM when scheduling projects of a repetitive nature; and these projects capitalize and make use of many of LOB scheduling benefits. One of the interviewees explained how in repetitive projects, LOB scheduling is more beneficial in areas like managing the project resources, visualization of the project schedule, creating schedules more efficiently, managing and updating the schedule, and decreasing the chance of scheduling errors. He believes that for projects of a non-repetitive nature, CPM and LOB are equally suitable and usable. Another interviewee believed that scheduling projects with a less percentage of repeated activities is one of the weaknesses of LOB scheduling. Even though, it is possible to schedule them using LOB, he still faced hardships doing so. A scheduling practitioner commented that LOB scheduling is more practical when used to schedule projects with a repetitive nature, however on other types of projects LOB loses many of its advantages. Another scheduling practitioner discussed how the LOB technique is better in scheduling repetitive and non-repetitive projects alike, because it allows for easier tracking of productivity rates through inspection of the scheduled activities' slopes. Furthermore, he discussed how LOB permits enhanced management and tracking of sub-contractors' work on the project site. The academician explained how the strength of LOB is its

ability to schedule repeated activities with the same crews or resources over various locations, and if the repetition of the activities did not exist, then LOB scheduling loses its edge. The academician stated “If you don’t have a lot of repetitive activities, than Line of Balance doesn’t make sense, because its strength is in how you could optimize your resources over different locations or zones. If I’ve got a project where each crew is only going to do one thing and show up one time, than Line of Balance doesn’t make much sense. I can just use a CPM and optimize the use of my resources.”

The study also attempted to investigate various advantages and limitations of applying LOB scheduling to construction projects, and how it compares with CPM. Some of LOB scheduling advantages discussed by the interviewees are listed below:

- Clearly shows the amount of work taking place in a certain area at a specific time of the project.
- Has the ability to show and optimize the resources used for large number of repeated activities, executed in several zones or locations.
- Easier cost and time optimization analysis because of all the information available for each activity in the project.
- Ease of setup and its superior presentation and visualization.
- Easier to modify, update and change the schedule.
- Better managing of all the various sub-contractors in the project.
- Allows for simpler and clearer resource management and resource optimization functions.
- Better consideration of the site space which enhances the management of the crews and resources involved in a certain spot at a certain time of the project.
- Visualization of productivity and location of crews.
- Generates schedule forecasts, based on the information of the “actual built” productivity rates.

The major disadvantages they discussed include: the difficulty to schedule soft activities (like procurement or milestones activities), activities could only be divided by locations and not by systems or any other classification or grouping, and LOB scheduling inability to generate a clear critical path for the project. Below, is a table presenting the interviewees comments and opinions regarding the limitations of LOB scheduling. The limitations are listed in the first column, and clarifications/comments provided by the Vico representative on each limitation are found in the second column of the table. From the Vico Representative’s comments it can be shown that most of the limitations and disadvantages are due to the users’ lack of understanding of the LOB methodology and/or software tool, rather than intrinsic shortcomings of LOB scheduling.

Table 1

***Limitations and disadvantages mentioned by the scheduling practitioners and academician; and the comments provided by the Vico Representative on each point.***

<b>Limitation &amp; Disadvantages</b>	<b>Vico Representative Comments</b>
Inability to generate a clear critical path of the project schedule, relative to the one provided by CPM schedules.	The critical path could be produced in the Gantt chart view in Vico Control®. Furthermore, the critical path is a concept that could not apply to LOB scheduling because it is a completely different methodology.
Could only be divided by location.	Projects could be divided by tasks, systems or trades rather than locations. The software allows users to set the breakdown structure to be compatible with these divisions.
In CPM scheduling the user could divide project by location and other systems like trades, in LOB only location.	Although a CPM schedule could reach the same objective in showing locations, it will be more difficult to visualize because of the relatively large number of pages. Trying to manage the crews and resources using a Gantt chart schedule will be time consuming and challenging, and if the user uses a filter, they will lose information concerning the dependencies.
Productivity rates in LOB schedule do not include the effect of crews’ learning curve, or if the individuals working in the crews changed.	With the forecasting feature in the program, the user could easily identify where he/she overestimated or underestimated the productivity rates and resources assigned to the activity and adjust them accordingly.

The interviewees were asked a series of questions concerning the relationship between LOB scheduling and Building Information Modeling (BIM) technologies. Three out of the five scheduling practitioners interviewed agree that LOB scheduling complements BIM and 4D modeling technologies and ideas, better than CPM schedules. One of the interviewees explained that because LOB scheduling is based on location, it makes more sense when it is connected with the 3D model. He added, that the combination of the LOB schedule and the 3D model allows for better management and tracking of the project, once the project execution phase commences. Furthermore, he explained that tying the LOB schedule with the 3D model generates more accurate quantities, and this leads to more accurate estimates of the project's time and cost. Ultimately, this produces more dependable estimates and schedules of construction projects, something extremely valued and crucial for project owners and engineers. He stated that:

*Line of Balance scheduling would be superior when used with BIM and 3D models just because of the spatial nature of both their presentations... The combination of BIM and LOB provides exact quantities which generates more accurate schedules and estimates... LOB also gives a relatively more accurate estimated time and cost of the project, relative to CPM. Currently, using CPM you have to add extra padding and float to account for the lack of accuracy of the estimated data, which result in a distorted picture of the project. So I think that the LOB tied with the model gives a high level of confidence of the accuracy of the quantification and the accuracy of the presentation of the production, provided the productivity assumptions are correct. So it lends a lot of credibility to the ultimate schedule and the estimate presentation, because it is all based on very hard and real numbers.*

Moreover, another scheduling practitioner commented that LOB scheduling complements BIM and 4D Modeling technologies and ideas because the schedule is developed in the same way the project would be built, resulting in accurate and realistic schedules. He discussed how one of the major benefits of creating a schedule from quantities extracted from a 3D model, is that it is not heavily dependent on the schedulers experience and knowledge in approximating durations for the estimated quantities of all the various trades included in the project. So the scheduling process becomes more automated and less dependent on the user's experience and knowledge. The Vico representative explained that because LOB scheduling is divided and based on location, it could be tied with the 3D model a lot easier than CPM schedules. He explained that having the LOB schedule tied to a 3D model allows the users to visualize the execution sequence of the project, based on the schedule they create, and this has proven to be one of Vico Control® most valued advantages. He said that this option help eliminates many scheduling mistakes and aid in visualizing the schedule sequence and rational. The Vico representative stated that the major benefit of combining LOB scheduling and BIM technologies is that in a short time and little effort, the user could run iterations of scheduling scenarios, observe how they will be executed, and assess all the various scheduling ideas and options.

## Conclusion

The research has shown that most of the Line of Balance (LOB) scheduling practitioners interviewed are satisfied with the scheduling technique and prefer using it over the Critical Path Method (CPM). They all discussed a myriad of LOB scheduling advantages and demonstrated how it helps in improving the planning and managing processes of construction projects. Even though, they commented on how the Vico Control® software program still needs improvement and upgrading, they stated they would not have implemented LOB scheduling without a software program. Most of the observations made by the interviewees coincide with the information found in previous researches. Some of the LOB scheduling advantages mentioned by the interviewees were parallel to those discussed by Chrzanowski and Johnston (1986). They explained how LOB scheduling is effective in applying changes in job progress, resource allocations, performing schedule changes efficiently, and simplicity and clarity of the whole project schedule. They also discussed how, after some study of the schedule, the user should be able to understand the flow of work through the project and comprehend the reasoning for performing the work in the illustrated manner. Most of these advantages were part of the scheduling practitioners' experience and were mentioned in their replies to the interview questions.

The information provided by the participants in the interviews show how the rarity of LOB scheduling supporting software programs is a primary reason for the limited use of LOB scheduling in the construction industry. Their comments also demonstrate how the introduction of Vico Control® increased the practicality and feasibility of the application of LOB scheduling.

Overall, the study shows that there are numerous intrinsic advantages and benefits for applying Line of Balance scheduling in construction projects. The availability of supporting software programs like Vico Control® help realize these benefits. Furthermore, LOB could play a major role in facilitating the implementation of Building Information Modeling technologies. The research shows that there is great potential for Line of Balance scheduling in the construction industry, and in the future there is a good chance that it would be implemented in more construction projects. With the developing and upgrading of Line of Balance software programs, and construction related academic programs integrating the LOB scheduling technique in their curriculums, the acceptance and utilization of Line of Balance is expected to increase significantly.

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