Lean in project-based organizations

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Abstract
Literature on the application of Lean in project-based organizations (PBOs) is scarce. This paper presents findings from two case studies of early efforts to implement Lean in subsidiary PBOs. By focusing on Lean principles we provide insight into how PBO operations are, and potentially could be, aligned with Lean thinking. The findings suggest a fit on an overall level, but that principles need to be aligned with PM methods and tools to allow for flexibility.

Keywords: Project Management, Lean, Improvement, Project-based organization

Introduction/Background
There are several ways to describe Lean, but on an overall level the concept commonly includes a focus on optimizing the value-flow in processes through continuous improvements. Although originally applied in manufacturing and production settings (hence Lean Production/Manufacturing, Hines et al., 2004) Lean has over time been introduced in less repetitive environments such as health care, and as discussed here, related to project management (PM) (e.g. Ballard & Howell, 2003; Saier, 2017; Staats et al, 2011). With the growing application of projects as a way for organizations to both develop and do business (Bakker, 2010), the need to simultaneously manage multiple projects have risen. Managing multiple projects is especially important in project-based organizations (PBOs), where the project is the primary unit for production organization, innovation, and competition (Hobday, 2000). While there is research contributing to the understanding of Lean in projects (e.g. Ballard & Howell, 2003; Saier, 2017; Staats et al, 2011), the literature on Lean in multi-project settings such as PBOs is scarce. A PBO can operate either as a standalone or a subsidiary unit, delivering products or services through projects, to external or internal customers (Pemsel & Müller, 2012). The PBO form of organizing is suitable for e.g. managing changing client needs, to manage cross-business expertise, and handle uncertainty, but described as weak for e.g. routine tasks, economies of scale, and promoting organization-wide learning (Hobday, 2000). Interestingly, the weaknesses of a PBO (e.g. organizational learning and routine tasks) are described as the strengths of Lean (e.g. Hines et al., 2004). Further, as with Lean, a process approach (e.g. Packendorff, 1995) focusing on value creation (Winter et al., 2006) is promoted in PM. Granted that value creation through processes is central to
Lean thinking (Womack & Jones, 2003), the promotion of said approach would indicate a basic prerequisite to implement Lean in PBOs. Based on empirical observations, we argue that a subsidiary PBO may be more or less forced to incorporate Lean, as the result of Lean being implemented in the parent organization. Consequently, the PBO can choose to either reactively adapt to, or proactively adopt, Lean. Hence, this paper explores the potential to introduce Lean in a multi-project setting. To narrow the scope we have chosen to focus on Lean principles (and underlying values), since research related to Lean originally centers around organizational principles (Womack & Jones, 2003).

**Design/methodology/approach**

In order to understand the challenges faced by PBOs when approaching Lean a case study approach was chosen, since limited previous knowledge regarding Lean on a PBO level could be found (Edmondson & McManus, 2007). Another reason was the rich access granted to both case organizations, offering the opportunity for a deeper understanding of the fit between Lean and PBO operations (Yin, 2014). Based on the case study approach we focus on exemplifying (Flyvbjerg, 2006) as a way of understanding the phenomena under study. The two case organizations (Table 1) can be seen as subsidiaries (or departments) of their respective parent company, with the responsibility to oversee and manage projects for internal customers. By producing the majority of their products and services through projects, serving internal customers, they fall under the definition of project-based organizations (Pemsel & Müller, 2012).

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<tr>
<th>Table 1 – Case study organizations</th>
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<tr>
<td><strong>Country</strong></td>
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<tr>
<td>PBO A</td>
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<td>PBO B</td>
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PBO A was part of a 5-year (2013-2017) longitudinal case study, focusing on continuous improvement in PBOs. During the later stages of this period the parent company decided to implement Lean, starting the rollout in 2016. As a consequence, PBO A would encounter Lean both in the projects, and within the PBO, although formal implementation (in the PBO) had not been initiated. Initial discussions had been initiated regarding how to adopt Lean thinking and principles, in order to raise awareness and be prepared within the PBO (A). Data from PBO B was gathered as part of a master thesis in the industrial engineering and management program (MSc.), during the fall of 2016. PBO B had initiated the implementation of Lean on a senior management level during spring 2016, as part of a company-wide effort to further increase efficiency and effectiveness in the organization. The respondents were selected based on the senior position they held, and interview using a semi-structured approach. In PBO A, members of the PBO management team (Table 2) as the responsible party for PBO operations were selected, while in PBO B, where the implementation of Lean had started, the seniors responsible for the PBO as well as the implementation of Lean were selected (Table 2). All interviews were recorded to complement the field notes, as well as to facilitate the analysis in a later stage. For the data gathering and analysis we chose to focus on the five principles (see Lean Principles) of Lean as defined by Womack and Jones (2003), as they represent the core idea of Lean, while still being
general enough to be discussed in seemingly diverse contexts. By comparison, the five principles correspond to Process and Problem-solving of Liker’s (2004) 4P-model. Consequently, Liker’s corresponding principles (principles 2-8 & 12-14) were used to provide an updated and more operationalized formulation of the content of Womack and Jones (2003), although not explicitly discussed. Coding and structuring the data according to the principles provided a framework to analyze and present the findings.

<table>
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<th>Table 2 – Respondents</th>
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<tr>
<td><strong>PBO A (individual interviews)</strong></td>
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<td>- VP of Projects</td>
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<tr>
<td>- Senior Manager, Projects (North)</td>
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<td>- Senior Manager, Projects (South)</td>
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<td>- Senior Manager, Projects (Logistics)</td>
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<tr>
<td>- Productivity development Manager (Responsible for corporate Lean rollout)</td>
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<td>- Technology Manager</td>
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<td>- Administration Manager (7 of 7 managers interviewed)</td>
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**Lean thinking and lean principles**

What is Lean? There exist many different definitions of Lean and according to Hines et al. (2004) the concept is constantly evolving, implying that any ‘Lean definition’ can be seen as “moving target, only being valid in a certain point in time”. As we agree with the argumentation by Hines et al. (2004), we are also of the opinion that many Lean definitions are too narrow, i.e. going into specific Lean methods and tools (e.g. 5S, Kanban, and Value-stream mapping). Hence, this paper discusses Lean as a way of thinking, i.e. mainly the set of principles described by Womack and Jones (2003) focusing on value creation and the reduction of non-value adding activities in an organization which. These principles, if considered properly, provide guidance to apply suitable methods and tools for the specific context or environment of an organization. In their book “Lean Thinking” Womack and Jones (2003) describe five Lean principles that characterize the Toyota Production System (or the Toyota Way): (1) specifying value from the customers’ perspectives, (2) identifying the value stream, (3) making the value-creating activities flow, (4) customer pulled-value, and (5) pursuit for perfection. While these principles mainly comprise the production system, Liker (2004) later took on a wider perspective including Philosophy and People, illustrated in a 4 P model (where the other two P:s are Process and Problem-solving). While Womack and Jones (2003) present principles related to the value stream on an aggregated level, Liker (2004) provides principles on a more operationalized level covering all organizational aspects of Lean. Liker’s 4P model, including 14 Lean principles (see Findings), has been a well-recognized reference to Lean by practitioners and researchers. The last principle to strive for (i.e. the top of the pyramid) involves striving to become a learning organization, through reflection and continuous improvement. Becoming a learning organization is also considered desirable in the PM literature, e.g. promoted as the highest level of PM maturity (e.g. Pretorius et al., 2012). However, Scarbrough et al. (2004) discuss that while projects constitute favorable settings for learning, the autonomy might also limit the incorporation of the lessons learned in the wider organization (e.g. the PBO). Hence, one of the reasons for studying the implementation of Lean thinking in PBOs is that organizational learning from projects is a well-documented challenge (e.g. Scarbrough et al., 2004). Another reason is that a precondition to manage projects effectively and efficiently in a PBO, an organizational project-process view is needed (Chronéer & Backlund, 2015).


**Lean and Project Management**

By comparison, Lean and PM appear to be opposites of each other. Lean has its roots in a manufacturing setting, characterized by well-defined (discrete) and repetitive processes. PM on the other hand is often characterized by uniqueness, with a high degree of uncertainty, and ad hoc problem solving throughout the project. Also, while Lean promotes a long-term holistic view (Liker, 2004), PM is often described as focusing more short-term, mainly centered on the steering parameters of cost, time and scope (e.g. Geraldi & Söderlund, 2016). However, there are also similarities, for example both Lean and PM aims at creating value for customers through a process approach. There are limited articles to be found on the topic ‘Lean Project Management’ (Lean PM) in the research literature (“lean project management”, Scopus, n=10, Web of Science, n=3). The main body of research literature regarding Lean PM can be found within the field of Lean construction, a concept coined by Koskela in (1992), where construction projects are viewed as temporary production systems. When such productions systems are structured to deliver the product while maximizing (customer/client) value and minimizing (project) waste, they are said to be ‘Lean’ (Ballard & Howell, 2003; Saier, 2017). According to Pons (2008) the construction industry has moved from a craftsmanship approach towards standardized construction processes, which makes Lean an attractive way towards increased efficiency and effectiveness. In a similar way, Lean PM can also be found related to product development, i.e. with a focus on reducing costs and time-to-market (see e.g. Nepal et al., 2011), though how is not fully understood (Pons, 2008). For example, removing any slack to create efficient processes may be an issue, as projects may imply high uncertainty and a need of dynamic structures. Similarly, Nepal et al. (2011) argue that simultaneously working on multiple projects could cause delays, but since resources can be shared, it’s not necessarily ‘waste’. Hence, In order to link Lean manufacturing to Lean PM, it is important to clearly understand and define non-value added activities in PM processes (Nepal et al., 2011). Further, Staats et al. (2011) studied the applicability of Lean principles in software development projects, as an example of ‘knowledge work’, i.e. the management of information. They give three examples of differences from a manufacturing context, which impede the use of Lean principles since knowledge work: 1) typically has a more dynamic character, 2) processes are often abstract, and 3) often includes both high- and low-level exploration. However, Staats et al. (2011) conclude also that Lean has potential for improvements in knowledge work, for example in problem solving, and in streamlining and simplifying processes. While presenting several interesting results concerning Lean in different project contexts, more studies are needed (Ballard & Howell, 2003; Pons, 2008; Staats et al., 2011).

**Findings**

The following section presents the findings from the case studies of two subsidiary PBOs, PBO A and PBO B (see Tables 1 & 2). The findings are structured in accordance to Liker’s (2004) Lean principles, specifically those related to Process and Problem solving (principles 2-8, 12-14). Each principle contains a short concluding analysis. The subsequent sections discuss relevance and contribution.

**Principle 2 - Create a continuous process flow to bring problems to the surface**

In Both PBOs a formal and documented project model was employed, defining the PM process. The focus group (PBO B) described it as difficult to find a usable process description due to abstract activities (e.g. flow of information). Given the long time-
span of their projects (3-5 years) it was considered a challenge to finding a process level that both captured the overall progression towards completion, and that was detailed enough to encompass progression between meetings. An existing PM process had been implemented on a corporate level, however the respondents indicated that the project managers did not follow it, and that the degree of compliance varied. In PBO A a PM process had already been defined prior to the introduction of Lean, in terms of the previously described PM process. Two of the respondents described having identified a problem with the process description for basic engineering, in that the description was not detailed enough. The output from the basic engineering process was input to the construction process, at which stage the input was identified as inadequate many times. The identified cause of the problem was an insufficient process description, resulting in inadequate reports from inexperienced project managers. In addition, experienced project managers produced reports that exceeded the description, and as a consequence the respondents had started to update the process description to reflect the good practice.

The difficulties in PBO B to describe a useful process indicate that the project process could be hard to define to serve the purpose of Principle 2. However, the example from PBO A illustrates how process descriptions can contribute to bringing problems to the surface. The defined processes in PBO A were described as ‘tailored’ to their activities, indicating that having tailored processes can help bring problems to the surface (at least some problems, see Principle 5). The main issue for principle compliance is the lack of a PBO-level process, defining the value stream on an aggregated level. This poses both a challenge and opportunity for subsidiary PBOs.

Principle 3 - Use “pull” systems to prevent overproduction
All respondents discussed “pull” in terms of customer demand. Projects are commissioned to the PBOs, but the respondents in PBO A described a problem with customers who defined their need based only on their own business, risking misalignment with company strategy (i.e. sub-optimization). Early project phase involvement of the PBO (identifying and defining the need) resolved this, but many times the customers initiated projects on their own. Further, the focus group (PBO B) mentioned over-deliverance in terms of the technology delivered in projects (more advanced than requested). The reason for this behavior was accredited to generous budgets, and a desire to deliver ‘the best technology possible’ within the technology department. The over-capacity could potentially be a problem if it will never be utilized, since the resources consumed could have been put to use elsewhere.

The findings describe “pull” in terms of customer demand, not described as part of the defined processes (as intended in Lean). Further understanding of how “pull” is practiced within the processes is consequently needed. The abstract nature of projects (Staats et al., 2011), as well as being temporary and changing in nature, pose an interesting problem regarding a “pull” approach.

Principle 4 - Level out the workload (both people and equipment)
The workload for project managers was described as varying, and all respondents emphasized that projects were always ‘tail-heavy’, meaning that the workload inevitably increases in projects near completion. In PBO A non-regulated working hours were applied for the project managers, making it difficult to monitor the workload. One respondent explained a work-relationship built on trust, and that if a
project manager felt overburdened that individual would raise the issue (however that seldom occurred). Further, as the majority of project managers managed more than one project at a time (parallel and overlapping), the management team assigned projects to avoid assigning two projects with the same, or close, deadlines to the same project manager. In contrast to projects being described as ‘inevitably tail-heavy’, respondents (PBO B) described a culture of procrastination, with project managers postponing activities closer to project delivery. The effect of this behavior was described to be an increase of risk, since unforeseen problems would be more difficult to resolve closer to deadline. No further inquiry as to the effects, or causes, of procrastination was made.

As varying workload was considered as natural in PM, and no one seemed to complain, we cannot know for sure if this is a problem. Staffing project managers with overlapping rather than parallel project could be seen as one way to level the workload. From a Lean perspective leveling the workload is important to avoid problems, and the example above (procrastination) suggests that there is at least some room to level out the workload (i.e. improved planning) and make project less ‘tail-heavy’. Further study is needed.

Principle 5 - Build culture of stopping to fix problems, to get quality right the first time
One respondent (PBO A) explained that, “once a project is started, it can not be stopped.” Instead restarts or revisions were used if projects deviated or the intended outcome would not be delivered. Instead of stopping projects several respondents explained that problems were often resolved ‘on the go’ (quick-fixes within the project). However, no indications were given as to whether improvements were made to prevent the problem from occurring in future projects.

Stopping the process to fix problems seems to be an issue in PBOs. The findings indicate that problems are resolved locally (within projects) rather than globally (to benefit everyone). The example in Principle 2, regarding updating the basic construction process, however suggest that problems are resolved also on a global (PBO) level. As the process cannot be stopped, a system or routine for reporting problems is needed, managing the problem timely at the project level and to identify and resolve the root-cause at PBO level.

Principle 6 - Standardized tasks and processes are the foundation for continuous improvement and employee empowerment
On a general level all respondents described the approach to managing project as varying among employees. The opinion was that it did not matter which tools and methods they used, as long as the PM process was followed. One respondent (PBO A) emphasized the importance of having processes and standards that on one hand ensured delivery of the intended output, and on the other hand allowed for flexibility in methods used. The focus group (PBO B) described having multiple standards (e.g. meeting templates and progress reports), but that the standards were not always aligned with practice, as well as not used. Respondents also indicated that efforts to update standards would be very time-consuming.

The findings indicate that standards are being used on all levels in the PBOs, but to a varying degree. Project managers are described to deviate from standards if and when they experience a lack of fit between the standard and practice. The struggles to find an appropriate level of detail described in Principle 2 indicates that the challenge is more
of finding an appropriate level of description, rather than standards not being useful or applicable. Also, enabling rather than coercive (see Adler & Borys, 1996) standards seems to be needed to fit the dynamic nature of projects. In conclusion Principle 6 was not followed in either PBO, since deviation from standards was considered natural, and only limited follow-up an evaluation was reported (see Principle 2).

Principle 7 - Use visual control so no problems are hidden
In PBO A a new project management software with a graphical interphase had been implemented, providing some visual control of projects. They also utilized a ‘traffic-light’-system (green-yellow-red) to report on project progression during meetings, where ‘lights’ changed as problems occurred. As part of the Lean implementation the focus group (PBO B) described initial tests with visualization of projects and their progress, using boards. By using the boards the workload for the project managers had increased slightly, but they were positive and described the upsides to be easier governance and increased transparency, with a perceived increase in identified problems as the result.

Limited use of visualization was reported. Since knowledge work is often abstract (Staats et al., 2011) visualizing the process could pose both a challenge and an opportunity. The reported test from PBO B indicates that it is possible and can help to identify hidden problems (the example of basic engineering in Principle 2 also supports this).

Principle 8 - Use only reliable, thoroughly tested technology that serves your people and processes (technology should be “pulled” by, not “pushed” to, manufacturing)
Projects utilize technology in several aspects, and as described in PBO B technology could refer to (1) technology as part of the delivery and (2) technology as part of managing projects. Delivered technology was considered to be well tested and dependable, often more robust than needed (see Principle 3). Technology for managing projects referred to business systems, e.g. for documentation and reports, and was many times considered to be time-consuming and non-value adding. The lack of standards for which systems to use, and when, was considered a problem in PBO B. Similarly, several respondents (PBO A) described having an abundance of business systems in their parent company, causing frustration in the projects. The frustration was related to a feeling of spending time in things (e.g. reports) that no one ever looked at or used (‘waste of time’). However, one respondent (PBO A) presented a contrasting opinion arguing that it was natural for large companies to have several systems to work with, since different departments had different needs (i.e. learn to deal with it). Related, project managers were rushed to new projects when the previous was delivered (high demand), but not completed (e.g. documentation and unresolved minor issues). The behavior could potentially generate long-term problems (e.g. future projects or repairs) due to incomplete documentation. Another respondent described that it was not uncommon for experienced project managers to skip steps on the way in projects, as they were considered ‘unnecessary’ in terms of project delivery.

The principle seems to be applied for the delivered technology, but not for managing projects. The experience of having to work in several systems that did not support the project delivery could be an indication of technology being ‘pushed’, but as noted by one respondent all systems was not always intended to support projects, but instead to
support the company. Create routines and clarify the purpose could be one potential way forward to deal with the feeling of ‘wasting time’.

**Principle 12 - Go and see for yourself to thoroughly understand the situation**

To what extent ‘go and see’ was applied varied from individual to individual. On a project level some project managers (PBO B) spent a lot of time on site, while others almost never visited their sites. One reason for this was the remote location of many of the sites. In PBO A spending time on site was considered as praxis. Both PBOs had project offices close to the customer to facilitate site visits. On a PBO level senior managers (PBO A) were often part of the project steering committees as ways of understanding the situation. One respondent (PBO A) further explained that all senior managers also worked part time as project managers. This provided valuable input to the PBO level as they too got to experience the challenges and problems associated with project management. Another respondent (PBO A) explained that project had been delayed due to subcontractors not visually verifying their design, which was based on a blueprint that was not updated (by the company).

‘Go and see’ seems to be practices in PBOs, but the varying degree indicates the need to further formalize the principle. Interestingly, the example above suggests that it might not be sufficient to implement a ‘go and see’-principle only on an organizational level in PBOs, but also to make sure that everyone involved (e.g. subcontractors) follows it as well (e.g. through contracts) to ensure project delivery.

**Principle 13 - Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly**

Project management involves continuously making decisions, many taken by the project manager solely (part of the job). However, it also includes continuously informing and updating stakeholders to verify planned actions. Decisions affecting the projects (time/cost(scope) was taken in project steering committees, and described as consensus decisions (PBO A). On a PBO level (management team) one respondent (PBO A) described the ambition to always make decisions in consensus, a practice confirmed by the other respondents. In PBO B decisions were described as timely, but that execution would vary (see ‘procrastinate’, Principle 4).

All respondents described consensus as the preferred, and practiced, way of decision-making. In projects the continuous dialogue with stakeholders could be seen as a way of seeking consensus before taking action. To what extent decisions were executed rapidly was not clear, but the culture of procrastination suggest room for improvement.

**Principle 14 - Become a learning organization through relentless reflection and continuous improvement**

The final principle discusses is that of becoming a learning organization working with continuous improvement. The example from Principle 2 shows how the senior managers (PBO A) continually work on improving the performance. Other similar examples were provided, and lists of problems and improvement initiatives were applied and frequently updated on both a PBO and program levels. However, no systems, routines, or standards existed for learning and improving the organization. One senior manager, new to the PBO (A), had observed that many of the improvement efforts undertaken were rather extensive. Described as more or less ‘complete overhauls’, rather than continuous incremental improvements, the efforts seldom
reached full potential since it was difficult to see the large initiatives through. Another respondent (PBO A) described a shift in focus as part of the new management philosophy, from a focus on efficiency (delivering projects), to one of effectiveness (which project to deliver, and why, i.e. the value delivered for the company). One example of an activity to support organizational learning was the use of post-project reviews in the final project report (both PBOs). However, problems resolved during the project had often been forgotten at the end, and only limited information was included in the report. A desire to find a way to continuously capture lessons was expressed, but no solution had been found. One respondent (PBO A) described his position as an enabler of bringing together project managers who could learn from each other (e.g. resolve some issue). The approach was useful but had its shortcomings, since the transfer of lessons was limited to a few, not all, project managers, and the outcome depended on one single person (the manager).

Becoming a learning organization is a well-known challenge for PBOs (Scarborough et al., 2004). Post-project reviews were employed in both PBOs in order to capture lessons learned, but the approach has its shortcomings (e.g. lessons forgotten at the end, unwillingness to document mistakes). Although not formalized, the senior manager pairing project managers to support each other is one example of continual informal learning between projects. Scarborough et al. (2004) describe that learning takes place in two levels, the project- and the organization level. The challenge then is to bridge these levels. The example regarding process update in Principle 2 illustrates an effort for organization-wide improvement based on a problem (and solution) identified on the project level. However, there was no formal way of disseminating the lessons learned to the PBO, instead it would be up to each senior manager to update and educate the staff of the changes.

Conclusion
The findings suggest that Lean principles are relevant in PM settings, and in many different ways can support a PBO in managing projects efficiently and effectively. However, based on the study of two PBOs introducing Lean thinking, each principle have to be applied and followed up at the different organizational levels (PBO, project, individual) to obtain the full potential. Though, compliance to processes and the lack of standardized ways of working seems to be a general issue in PBOs. To define customer value is a central aspect of Lean (Womack & Jones, 2003), but has not been explicitly addressed in this paper. However, value was discussed in the interviews, and preliminary findings indicate that for subsidiary PBOs ‘customer value’ seems to be somewhat complex, due to PBO and customer belonging to the same organization. We intend to present a more thorough analysis of ‘value’ in a future paper.

Relevance/contribution
We provide an empirically based discussion of opportunities related to Lean in PBOs. We also suggest that the nature of PBOs allows for the adoption of general Lean principles, but that they need to be aligned with PM methods and tools to allow for flexibility. Further, the findings suggest that adaptation of Lean is not only necessary for different contexts, but also within a specific organization. To further understand the challenges and opportunities of adopting Lean in a subsidiary PBO more research is needed. Revisiting the case organizations, or to identify PBOs with more Lean experience, would be one way to understand how the principles are adjusted to the PBO, and how the PBO adjust to the principles.
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