

LESSONS FOR CONSTRUCTION: DELIVERING MEGA PROJECT ON TIME THROUGH CULTURE AND HOSHIN KANRI

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ABSTRACT

Managing risks in mega projects has received a lot of attention in the construction community. However, very few empirical results have reported on-time and on-budget deliveries. This paper presents a case study from a closely related industry, offshore oil and gas construction, where the lean project management and culture method Hoshin Kanri was implemented on a mega project. The results of implementing Hoshin Kanri in this case have been very positive, with project lead time reduction of 10 percent, risk incentive account of USD 1 billion saved, and a potential of an additionally revenue of 2.8 million USD/day due to reduced lead time and early production startup. The paper reviews how Hoshin Kanri is implemented in this specific mega project, and compares it to other industries, processes, and previous IGLC research to extract lessons to be learned for the construction industry. The implemented Hoshin Kanri was found effective in developing the interlinkage between the strategy and project organization from upper to lower levels. The contribution of this paper is to illustrate the benefits of Hoshin Kanri and to propose further development of this within the construction community.

KEYWORDS

Hoshin Kanri, Mega project, Visual management, Culture, Collaboration.

INTRODUCTION

Through analyzing 205 mega projects in offshore oil and gas, EY (2014) finds that 73 percent of these report schedule overruns and 65 percent report cost overruns. Further, EY (2014) divided the projects with cost overruns into six regions and analyzed the average budget overruns to be: North America (51%), Latin America (102%), Europe (57%), Africa (51%), Middle East, (68%) and Asia Pacific (57%). EY (2014) findings reveal that managing mega projects in oil and gas involves great challenges and emphasize the need for a shift in management approach in mega projects in offshore oil and gas.

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Not only EY (2014) has documented the complex nature of mega projects and its many risks. Sanchez-Cazorla et al. (2016) present a literature review of previous research on risk in mega projects across several industries (listing both construction and oil and gas) and conclude that cost overrun and schedule delays are everyday life, but no detailed and consistent categorization of risk exist due the complex and adverse nature in these types of projects. Flyvbjerg (2014) adds to this by outlining that only one in ten construction mega projects is delivered on time and budget. Flyvbjerg et al. (2003) further describe construction mega project economy, risks, and impacts on society and environment. Kardes et al. (2013) elaborate further on these impact factors and categorizations that define a mega project. According to Kardes et al. (2013), projects with above 10 diverse teams, multi-million-dollar budgets, complex contract structure, and time frames stretching across multiple years can be defined as mega projects. Furthermore, authors agree that the multiple high complexities accumulate and increase the risks in these types of projects (Bruzelius et al. 2002; Flyvbjerg et al. 2003; Kardes et al. 2013; Sanchez-Cazorla et al. 2016).

Looking at EY (2014); Flyvbjerg (2014); Flyvbjerg et al. (2003); Sanchez-Cazorla et al. (2016), it becomes clear that mega projects within both construction and oil and gas contain large risks and share the trend of overrunning budget and time, strongly indicating that they are very much alike.

Within manufacturing, similar complexities arise; hence, productivity, risk, and cost management have been focus areas for decades. The Toyota production systems (Liker and Meier 2006) and lean has cemented itself as a highly functional toolbox to accommodate these focus areas (Dennis 2010; Womack and Jones 2003). Giordani da Silveira et al. (2017) describe how Hoshin Kanri, another lean tool, can assist organizations in achieving goals and improving their performance through their most important resources—the people. Hoshin Kanri has been described by Hutchins (2016); Jolayemi (2008); Nicholas (2016); Tennant and Roberts (2001a) as a method for strategy and policy deployment that strengthens the continuous improvement culture.

In this industry paper we will address how the lean method Hoshin Kanri is successfully being used to manage a five-year-long and USD 4.6 billion large offshore oil and gas redevelopment mega project, within both planned budget and schedule. The paper is highly relevant for construction for two reasons: 1) both construction and oil and gas mega projects are project-based construction, contain large risks, and face the inherent nature of overrunning budget and time. 2) Looking at EY (2014), keeping a mega project like this within budget and schedule is remarkable, especially since EY (2014) argues that projects executed on deep water are the most complex.

Looking at previous research, lots has been published on both mega projects and Hoshin Kanri, but not the two together. Thus, this paper will contribute to the body of knowledge by presenting how Hoshin Kanri can successfully be applied in a mega project.

CASE DESCRIPTION

This industry paper focuses on an offshore oil and gas production field with its platforms located in the North Sea. The case platforms hold wellheads, processing facilities, accommodation, flare stacks, risers, etc. The field was brought online in 1984 and produces daily 60,000 barrels of oil and 6.7 million m³ of gas. The extraction of gas from the field's gas reservoir has been done without water injection, meaning that

the pressure has continuously depleted, causing the subsurface to steadily subside. As a result, the case platforms (among others in the field) have since 1987 subsided from their original designed air gap of 20 meters to now a 14–15meter gap between sea level and platform.

As a consequence of the reduced current gap, platforms are no longer in compliance with the structural code described in ISO 19902. This means that a risk exists of extreme waves hitting the platforms, causing partial or full collapse. The case owner has thus initiated a comprehensive redevelopment project of the entire offshore oil and gas field. This redevelopment project will ensure that platforms will comply with the ISO 19902. The redevelopment project will over a period of five years (2017–2022) re-establish inherently safe operations at the offshore installations by:

- fabricating new topsides and bridges and installing these with appropriate gap to sea level.
- installing a new process module and a new utility and living quarters module.
- removing and disposing of redundant facilities.
- safe guarding production from the southern oil fields during the shut-in.

The redevelopment project budget is USD 3.6 billion with a risk contingency budget of an additional USD 1 billion, giving a total budget of USD 4.6 billion. The project is approximately halfway through and currently below budget and ahead of schedule. The redevelopment project will enable the field to continue full operation until 2047. The following will show the steps which were crucial for the successful implementation of Hoshin Kanri in this offshore oil and gas mega project. The case materials have been captured by one of the authors direct involvement in the project organization as a change agent. The author has previously worked with strategy implementation and found the Hoshin Kanri approach, to be a supportive structure, with a focused way to keep the plans and execution thereof on the right path. When starting up on the mega project, he realized that it could be handled with this approach, to act upon deviations and focus the efforts where most value is created. This involvement led to longitudinal access to the organization and data such as progress and milestone reports. Having an active role in the implementation and sustention of this, enabled the understanding of the dynamics throughout the developing progress with Hoshin Kanri since 2017.

HOSHIN KANRI—THE ENABLING STRUCTURE

Hoshin Kanri is a management methodology designed to use the collective thinking power of all employees to make the organization the best in its field (Hutchins 2016). Hoshin means "compass needle" or "direction," and Kanri means management" or "control." The goal is to get everybody pointed in (and working toward) the same direction, often referred to as "true north."

The philosophy behind Hoshin Kanri is that people are highly motivated by relations and results (Hutchins 2016; Nicholas 2016). To get the results, people need the right structure for delivering a good job (Dennis 2010). Such a structure is enabled by the right behavior, which was addressed in the latter and could be summarized in the following way: ownership, focus, relations, and leaders taking an active role in removing obstacles from the progress. The following presents the structure necessary for developing and sustaining the Hoshin Kanri deployment in the organization.

The structure operates in three different layers:

- Yearly cycle: Setting the focus and priorities for the coming year (Hutchins 2016)
- Monthly cycle: Monthly check-ins at milestones and leading indicators using the PDCA cycle
- Weekly cycle: Weekly meetings at team and project level to empower the whole organization using the PDCA cycle

Yearly Process

The purpose of the yearly process is to define the Hoshin Kanri X-matrix (Hutchins 2016); Tennant and Roberts (2001a) and SMART targets (Doran 1981). The X-matrix is also known as the Hoshin Kanri policy deployment foundation (Tennant and Roberts 2001a) and requires SMART targets (Specific, Measurable, Achievable, Relevant, and Time-bound), that allow managers to measure their performance. Inputs for the X-matrix and SMART targets comes from a cascade of information from the lower levels of the organization and upward with each team reporting progress and deviations from the original plan.

Based on the reportings from the monthly and weekly cycles, the leadership team perform the yearly cycle, which is divided into two sessions, “status” and “target setting,” focusing on current and future project performance. Outcome of these sessions is the status from the previous year and the improvement areas (targets) needed for the project to succeed toward the ambitious stretched target (shortened schedule). The overall project targets are registered in the Hoshin Kanri X-matrix for the project level (Hutchins 2016). For each project priority and major activity, a milestone certificate is created. This creates a plan covering the path toward to delivering on the priorities and contains actionable steps toward the target result for the activity.

These are the steps for the project leadership improvement area and target session:

- Align targets with critical success factors
- Ensure targets are in compliance with Team ONE manifesto
- Make sure they follow established processes (cost, planning, risk, etc.)
- Prioritize, analyze, and choose targets and record and high-impact improvement areas
- Define project targets and measures for the coming year
- Assign accountable department for each improvement area and provide accountability

After the project leadership team has set targets and priorities, the accountable departments are decided. Then the “catchball process” within the project teams starts. A series of sessions are held with the individual teams to define how the different teams can support the overall targets and improvement areas. These sub-milestones end up in the X-matrix developed at team level. All steps (sub-milestones) are also defined as SMART targets to finish the yearly cycle. The process is done according to Tennant and Roberts (2001a) and the aim is to define the activities, focus areas, and targets that each project team needs to carry out in order to deliver on the targets and priorities defined by the leadership team. When the X-matrix for the project team is developed, the other teams adjust their matrices to fit into the overall X-matrix as described by Hutchins (2016); Tennant and Roberts (2001a).

Monthly and Weekly Follow-up

The aim with the monthly and weekly follow-up is to ensure performance accountability. This is done by having project and team performances checked against the plan, and target owners present challenges in their areas. This is done so all activities and milestones from the project plan and X-matrices can be broken down into tangible sub-milestones and sub-activities. These are then continuously monitored and followed up on by the responsible managers. The sub-categories are broken down by each individual activity or milestone owner, which could be considered equal to the foremen's social interaction during Last Planner System (LPS) (Ballard 2000) meetings, where obstacles are identified as a team. These follow-up meetings are interlinked, meaning that lower levels feed upward. This enables decisions to be taken at the right level of management and allows the project leadership team to make proactive decisions and thereby timely corrective actions. The leadership team meetings are all held in the project war room. Picture 1 shows the war room and its visual boards, which contain the following information:

- Critical success factors and leadership team manifesto
- HSSE information (Health, Safety, Security, Environment)
- Integrated risk schedule, including all activities, major milestones, and sub-milestones
- 90-day outlook for each of the teams in the project (high level)
- Cost and schedule performance
- Risk and opportunities
- Relevant performance and soft skill measures (e.g., happiness Likert scale)



Picture 1: Project management war room with visual boards

Weekly Process

The weekly processes follow the activities with small intervals, ensuring that deviations and actions are closely monitored. Throughout the year, the project has follow-up meetings on a weekly basis using visual management boards. It is an iterative process where the individual team/department meetings feed into the weekly project leadership

team meetings. This creates transparency and increases the ability to act in a proactive manor toward any of the identified challenges. All team boards include the supporting activities for all deliverables and progress tracking measures. Activity owners update their parts of the board according to the progress principle by Amabile and Kramer (2011).

Miscellaneous Meetings with Stakeholders

All major stakeholders, joint venture partners, energy agencies, and corporate functions are briefed from the public visual management board area. The briefing contains activities, status, achievements, and challenges to constantly ensure transparency and trust from all key stakeholders in the project. The global project team is briefed weekly from the board area via video conference.

HOSHIN KANRI IMPLEMENTATION STRUCTURE

The mega project leadership team has throughout the implementation of Hoshin Kanri been assisted by a facilitator (first author), who has continuously coached and trained the whole project team to follow the Hoshin Kanri processes to ensure organizational alignment. The implementation of Hoshin Kanri has been done in parallel with soft-skill development in both the project leadership team and project organization. Having a large focus on developing soft skills and hereby the wanted culture of openness and trust is a direct consequence of Peter Drucker's famous quote: "Culture eats strategy for breakfast." The following sections will first present how this project defined the critical success factors and behaviors that all soft skill development was steered by. Second, the structure necessary for managing a megaproject by Hoshin Kanri is outlined by explaining the structure of the yearly cycles, monthly cycles, and weekly follow-up meetings.

CULTURAL FOUNDATION—CRITICAL SUCCESS FACTORS AND BEHAVIORS

The project leadership team consists of directors, engineers, HR, procurement, planners, transport, operations & maintenance managers. This leadership team have developed the critical success factors with the project end state and goal in mind. These are absolute preconditions for designing and sustaining the Hoshin Kanri strategy (Nicholas 2016). The critical success factors from the case are presented below in Figure 1:



Figure 1: Project critical success factors

Figure 1 illustrates how the leadership team perceives the team dynamics and required mindset throughout the project. Successful delivery of the critical success factors is underpinned by the organization culture, capability (i.e., having the right people in the right place at the right time with the right mindset), and deployment of the Hoshin Kanri

method. The focus on organizational culture, capabilities, and Hoshin Kanri is what drives the continuous improvement process and is the process which sustains the long-term goals at all levels of the team. Focus on project goals throughout the organization eliminates waste generated from inconsistent direction and poor communication (Nicholas 2016). The observed benefits from this approach are listed below:

- The teams have experienced increased participation, alignment, and involvement toward breakthrough objectives.
- Deviations and improvement actions are handled as the continuous improvements are built into the planning cycle.
- It has created focus on “a few vitals rather than trivial many.”
- Outcome of the increased participation has been integration and cross-functional co-operation between teams and their members.
- The performance and deviations have been carefully monitored, leading to fast feedback and transparency of progress.

Knowing, as a team member, that one’s effort feeds directly into the overall project goals motivates to support the corporation and helps to sustain a learning environment where both successes and failures are used to drive improvements. The importance of ensuring that the project team understand how ones behavior is affecting the whole is also addressed by Neve et al. (2017). Often lean (or other equivalent) activities fail because organizations neglect the importance of getting the right culture and capabilities in place before progressing. In this project, the project leadership team established a “project manifesto” that underpins how the project team works together, makes decisions, communicates, and behaves to build the desired culture.

We prioritize TEAM ONE	We believe in good intentions	We drive simplicity	We win and lose together	We speak with one voice
We build on trust, respect and empowerment	We know results come from having the right	We create better interfaces between our teams	We explore how to make each other successful	We are all ambassadors for the project
We take an interest in each other	We take the difficult discussions if we have to	We promote collaboration at all levels	We speak up and ask for help when needed	We share important information
We celebrate our successes and have fun	We always look at the bigger picture	We empower decision making	We shield our teams	We always back the decisions

Figure 2: Project team values and statements

These values and statements are illustrated in Figure 2, and can be summarized into seven steps to successful execution, presented below:

1. Focus on the customer by integrating collaboration in design, planning, and execution.
2. Enable integrated collaboration by ensuring strong relations between project teams and key stakeholders through a trustful learning environment where mistakes are opportunities for improvements.
3. Plan and front-end load all major activities, including a coherent set of indicators (leading ones) covering the full activity set.

4. Establish one truth by prioritizing data governance and mandatory fit-for-purpose tools (i.e., do not use Excel to run a business).
5. Commit to transparency to avoid “big company disease” (Dennis 2010) by displaying all relevant information on visual management boards in public spaces.
6. React decisively (take immediate action) as soon as anything deviates or is outside a desired range.
7. Link actions with learnings through continuous sharing of learnings on a regular basis and lessons learned from major activities throughout the project.

ACHIEVED RESULTS

Main issues during the implementation were prioritizing of actions and handling how this can lead to “no action” as everything can’t be important. Furthermore it took team effort to understand the importance of working according to plan, which required focus on distinguishing between improvements and operations according to plan.

The achieved results of using Hoshin Kanri in this offshore oil and gas mega project are presented below: 1) budget and schedule; 2) culture—the backbone of Hoshin Kanri.

BUDGET AND SCHEDULE

- The project is on track and the ambitious stretched target (reduced schedule) is to start production in December 2021 instead of July 2022. This is a potential 10 percent reduction of the overall schedule duration. Furthermore, the risk incentive budget of USD 1 billion is not expected to be used due to early project delivery.
- This stretched target’s impact on revenue streams is huge knowing that the average production value of oil and gas is approximately 2.8 million USD/day.

CULTURE – THE BACKBONE OF HOSHIN KANRI

- Open culture is lived, meaning that people flag concerns and focus on continuous learning. For example, this had an impact on one of the production work scopes that was executed 15 percent faster than estimated, saving USD 2.5 million.
- The open culture results in constructive cooperation with the partners in the joint venture, allowing the team to reach out and utilize knowledge from the partners.
- Work happiness is measured on a quarterly basis. The development from August 2018 to January 2019 revealed a 12 percent improvement on the happiness score and is considered to have had a direct impact on performance and appraisal among colleagues.

DISCUSSION

COMPARING CASE TO HOSHIN KANRI AND MEGA PROJECT

LITERATURE

The results show that this offshore oil and gas mega project is staying within planned schedule and budget. The early project finish and early production start are forecasted to generate additional revenue. Compared with EY (2014), this is a big achievement, since the majority of the 205 analyzed oil and gas mega projects finished late and over

budget. It is argued that success is mainly due to a high focus on three key elements: 1) a sustainable strategy, 2) bringing risks to the surface early, and 3) the cultural foundation of trust, necessary for using Hoshin Kanri. Wood and Munshi (1991) argue that the top-down approach combined with bottom-up planning leads to a sustainable plan. Further, Wood and Munshi (1991) argue that Hoshin Kanri implementation fails if cross-functional cooperation is not present. Finally, they argue that implementation fails if the “catchball process” is not handled across the departments and if planned activities are not integrated with budget cycle. The latter described yearly process outlines of how the leadership team and organization mitigated these procedural risks by assigning accountable departments and using the “catchball process” across the organization. But is a sustainable strategy enough for successful execution? Giordani da Silveira et al. (2017) argue that cultural resistance becomes a main challenge for implementation of Hoshin Kanri. Melander et al. (2016) argue that SMEs through Hoshin Kanri introduce trust in their organizations, as the employees are involved in translating objectives into actions. In this case, the “catchball process” became the translation of priorities into tangible targets throughout the teams in the organization. Tennant and Roberts (2001a) argue that cultural resistance can be reduced by involving the different levels of the organization in the strategy work, which has been a focus area for the case organization. Bruzelius et al. (2002) argue that transparency and performance specifications could improve accountability in mega projects and potentially lead to successful completion. The mega project case chose visual boards to openly share their performance measures, creating transparency and enabling proactive decision making. Flyvbjerg et al. (2003) argue that the accumulation of risks is what delays mega project. Thus, managing risks (identifying, tracking, and handling) has been a continuous effort throughout the case project. The case project used throughout the yearly, monthly, and weekly cycles, the PDCA understanding, and the Hoshin Kanri FAIR model as Tennant and Roberts (2001a) also describe. Maybe the results could have been achieved without usage of visual boards, but no previous example of this is available.

COMPARING CASE TO LEAN CONSTRUCTION LITERATURE

The Lean construction conference has through the years brought various perspectives on how to plan and control construction projects. The Last Planner System (LPS) by Ballard (2000) has had a large impact on the community and industry. The LPS method, which has similarities to PDCA, focuses on achieving healthy tasks and social interaction between the last planners in lookahead and weekly meetings. The lean community has recognized the importance of the lookahead and make-ready process for a stable workflow (Ebbs and Pasquire 2018; Hamzeh et al. 2012). As the case project has a multiple-year duration, the yearly, monthly, and weekly meetings could be argued to have similarities with these making ready processes. But, as some of the case deliverables require more than a year of preparation, 6–8-week cycles would not be sufficient to make these ready. When talking lean construction community, the Location-Based Management System (LBMS) (Kenley and Seppänen 2010) would have to be taken into consideration as well. Seppänen et al. (2013) tested the LBMS ability to forecast activities in order to reduce risks and problem occurrence on construction sites. Similar to the Hoshin Kanri method, LBMS relies on actual progress to forecast outcomes. But where LBMS only looks at the project schedule, Hoshin Kanri forecasts on multiple levels. Kala et al. (2010) illustrated how 3D models and

flowlines combined with commercial figures became an integrated 5D model for the foundations in a complex hospital project. The integrated 5D model elevates LBMS and develops the understanding of the project progress and status. Further research would be required to compare these in depth. The intentions of generating project flow and reduce the risks from variants are identical for LPS, LBMS, and Hoshin Kanri, but the focus of the methods are different, thus potentially working well together as already presented for LPS and LBMS in Seppänen et al. (2010).

IMPLICATIONS FOR THE CONSTRUCTION COMMUNITY

Kalsaas (2013) introduced LPS to the offshore oil and gas industry, with the intention of increasing constructability. This reveals that similarities could exist between the production systems of construction projects and oil and gas projects, which supports the argument that Hoshin Kanri has implications in the lean construction community and construction industry. Sanchez-Cazorla et al. (2016) argue that general risk categorization can be difficult due to the project complexities. Here the transparency that the Hoshin Kanri method generates could have the implication that allows its decision-makers to identify risks early, on multiple organizational levels. Other implications could be the combination of Hoshin Kanri along with other already known methods within the lean construction community, as it has been seen with takt, LPS, and LBMS in different contexts (Frandsen et al. 2014; Seppänen et al. 2010). The authors propose that a hybrid or integrated solution might be applicable as proposed Olivieri et al. (2016) for integrating LBMS, LPS, and CPM. A hybrid could be argued to have Hoshin Kanri as the overall project management system, with LBMS for construction planning with LPS procedures to ensure healthy deliverables of milestones. Further research and development would be required to fully understand the potential for Hoshin Kanri as a strategic project management method for construction mega projects.

CONCLUSION

The case has illustrated the positive outcome of implementing Hoshin Kanri in a mega project in the offshore oil and gas industry. It was found crucial for the implementation and successful project progress that the culture was shaped through values and critical success factors. The culture further enabled flagging of potential risks and proactive decision-making, which led to risk reduction. The organization and meeting structure further enabled the continuous improvements and strategy processes. This paper sets an example of how Hoshin Kanri can be used in mega projects, but further examples are needed to fully understand its potential.

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