اجرا و مدیریت پروژه به روش اصول ناب
(Lean Project Management)

فصل دوم: بکارگیری مفاهیم و اصول روش ناب در مدیریت پروژه

بخش ششم: روش انجام تجمیعی پروژه (IPD) و ارتباط آن با روش ناب

ارائه دهندگان:

سید محمدرضا علوی‌پور

(PhD, PMP, CMIT)

کامبیز کردانی

(M.Sc., PMP)

What is Integrated Project Delivery?

Integrated Project Delivery (IPD) – an approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction. (American Institute of Architects)

What is Integrated Project Delivery?

Key Components:

- Multi Party Contract -
  - At least the Owner, Primary Designer and Primary Builder
  - Single Contract Amount Including Contingency
  - Profit at Risk for Partners to the Agreement
  - Guaranteed Costs for Partners Based on Audits
  - Shared Savings if Project Delivered Under Budget
- Implementation of Lean Concepts, Practices and Tools
- Intentional Creation of a Collaborative Culture

Key Elements of Integrated Project Delivery Contracts

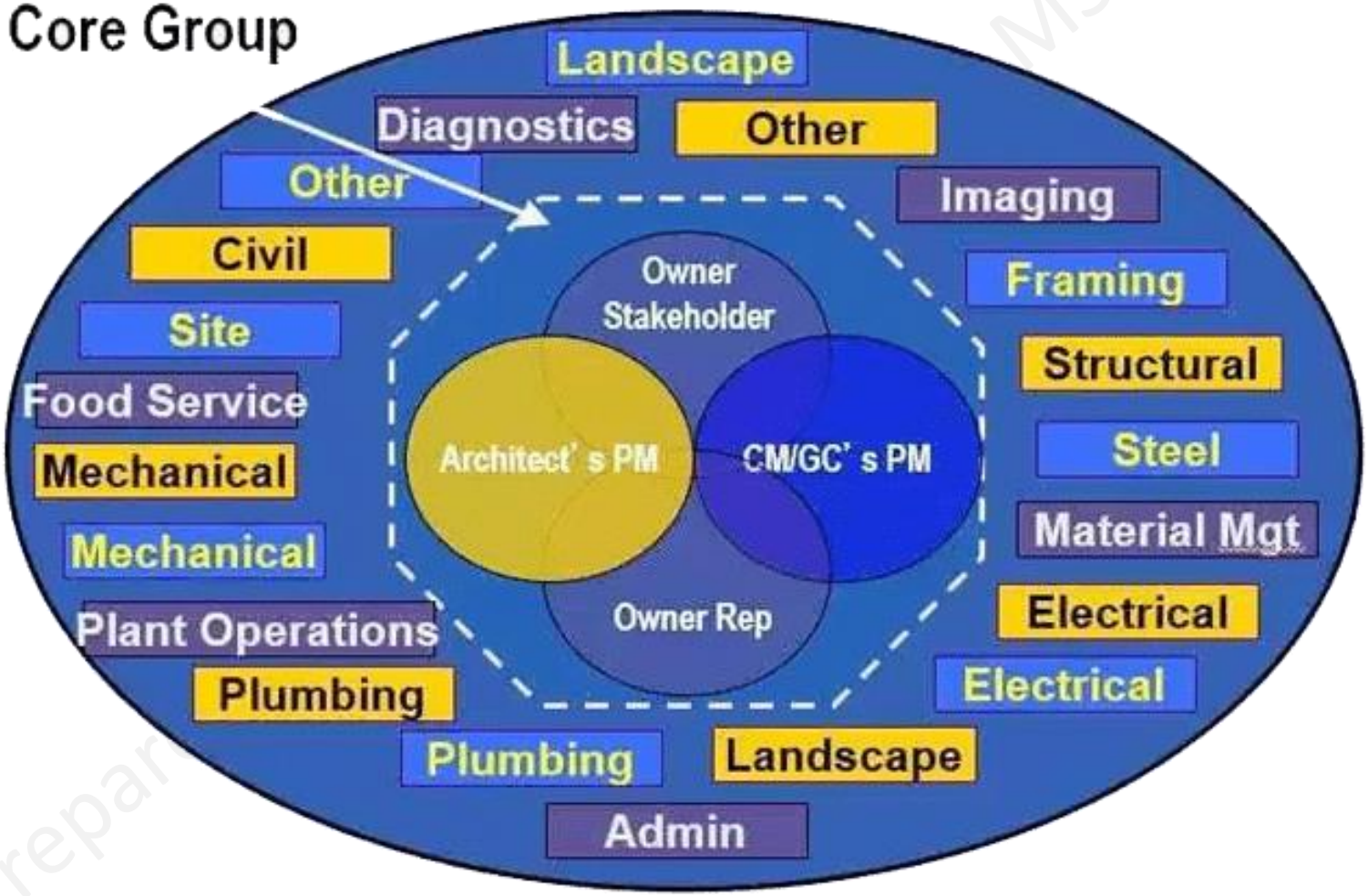
IPD Contracts consist of at least three parties:

- Owner
- Lead Designer / Architect
- Lead Builder / General Contractor

They may also consist of more parties in a Poly Party agreement. Example of other parties:

- Structural Engineer
- Mechanical Engineer
- Electrical Engineer
- Mechanical Contractor
- Electrical Contractor
- Concrete Contractor

Key Elements of Integrated Project Delivery Contracts



Key Elements of Integrated Project Delivery Contracts

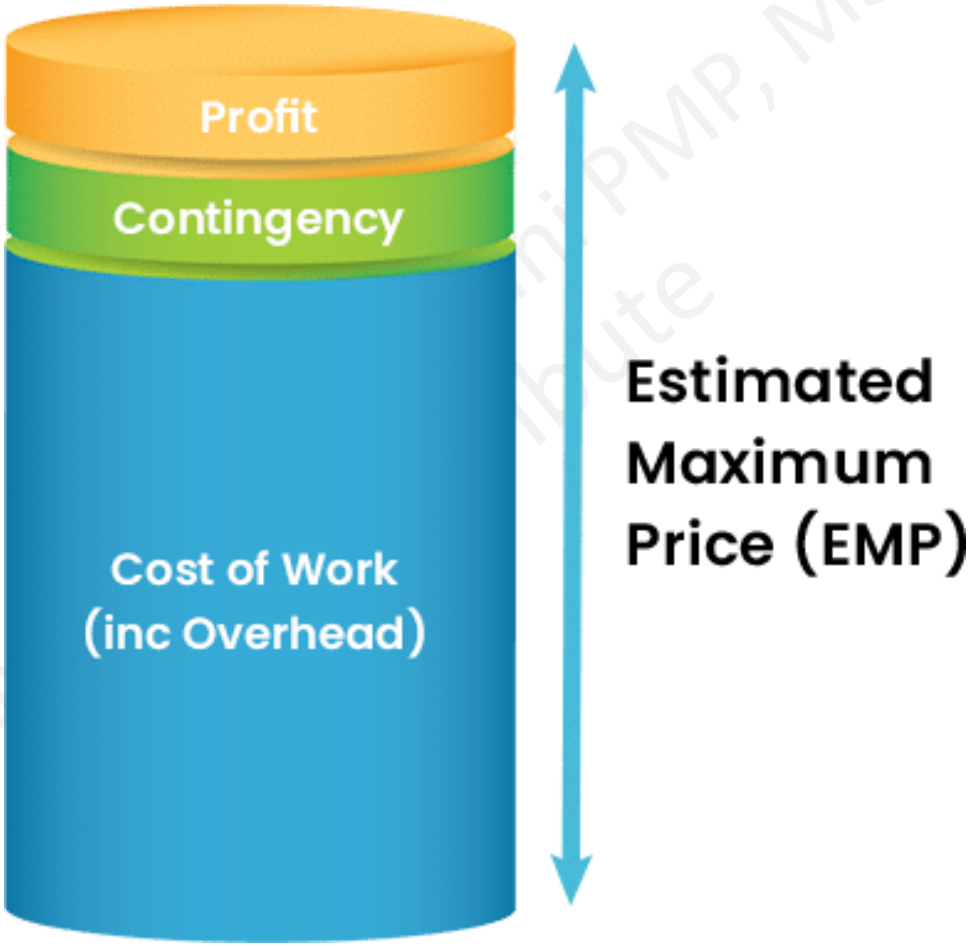
Design and Construction included in a single contract.

- Primary Designer
- Design Sub Consultants
- Primary Contractor
- Trade Partners

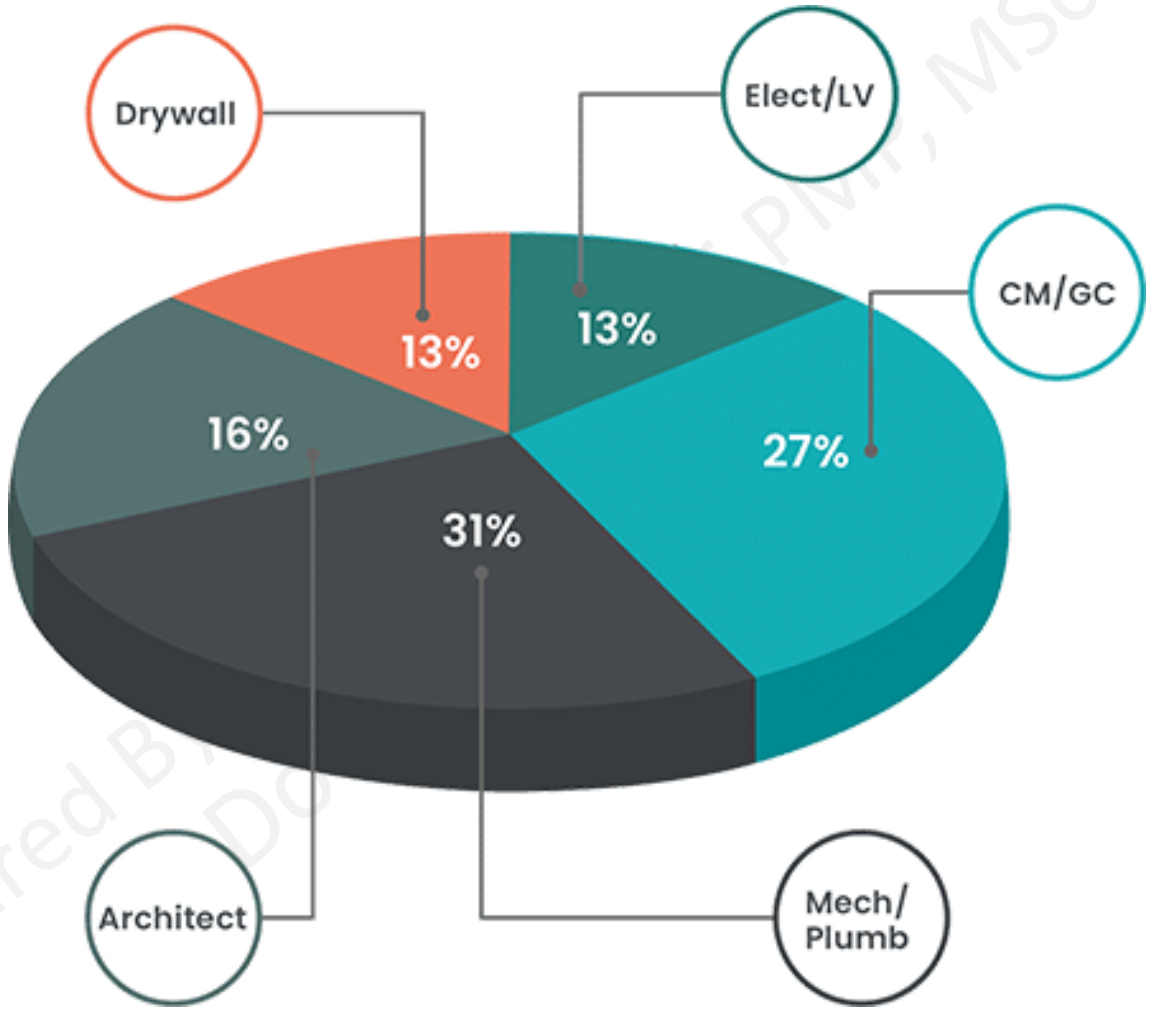
- Primary Designer
- Design Sub Consultants
- Primary Contractor
- Trade Partners

These costs are typically audited to separate out direct labor burden, indirect labor burden, home office overhead and profit.

Key Elements of Integrated Project Delivery Contracts



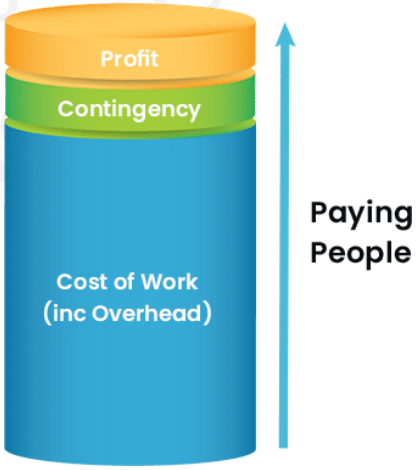
Key Elements of Integrated Project Delivery Contracts



Key Elements of Integrated Project Delivery Contracts

Costs for Partners are Paid Each Month Based on Actual Costs

- Labor is Billed Based on Time Cards
- Labor is Paid Based on Audited Rates
- Material is Paid Based on Actual Invoices
- Overhead for Designers is Included in Rates
- Overhead for Construction is Applied on Direct Costs
- Overhead is Capped Based on the Original Contract Value for Each Party
- Lump Sum Subcontracts are Paid on a Percent Complete Basis
- Profit is Withheld on Each Invoice for Partners
- Profit May be Released at Milestones if Financial Perfomance is Projecting Under Budget
- Team Report their Cost to Complete Projections to All Team Members on a Monthly Basis



Five Big ideas

Developed in 2004, The Five Big Ideas are Concepts that Support Successful Projects

Pros and Cons of Integrated Project Delivery

Pros

- Financial alignment of design and construction.
- Financial performance based on overall project outcome not individual firm performance.
- Profit is at risk if project goals are not met around schedule and budget.
- Team has "skin in the game" for activities during preconstruction.
- Traditional silos removed to allow collaboration.
- Complex projects can be collaboratively developed in new ways.

Pros and Cons of Integrated Project Delivery

Cons

- Upfront investment required early in the project (cashflow cannot be delayed).
- There is a diminishing return on preconstruction spend if design/permits take longer than planned.
- Without adequate time and complexity on a project, it may not be possible to find savings to cover the upfront investment.
- Owner's does not have a firm fixed cap on cost at the start of the project (it is debatable whether they ever really do in any delivery model).

the Truth is out there

- From Morris & Hough's "The Anatomy of Major Projects: A study of the reality of Project Management"

1987

There are hardly any reports showing underruns. ... in 3500 projects drawn from all over the world in several different industries, [cost] overruns are the norm, being typically between 40 and 200 per cent

the Truth is out there

- From Flyvberg's "Understanding costs in public works projects: error or lie?"

2002

90% of projects overrun their budgets at an average rate of 28%

the Truth is out there

- Report of the General Accounting Office of the U.S. Government on 32 Projects of the Veterans Affairs Healthcare System.

2009

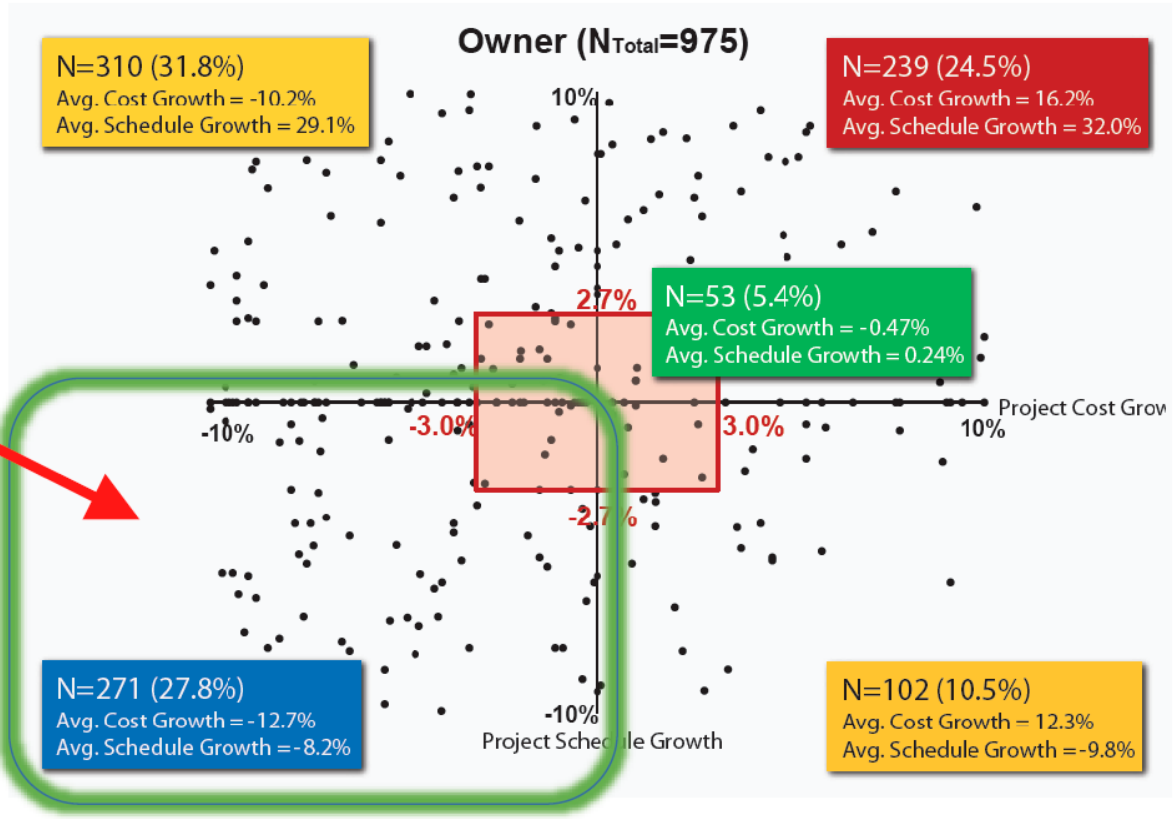
- **18 have experienced cost increases**
  - **5 of these are in excess of 100%**
- **11 have experienced schedule delays**
  - **4 of these are in excess of 2 years**

the Truth is out there

- U.S. Construction Industry Institute's Performance Assessment Study of 957 projects Average project size $65MM

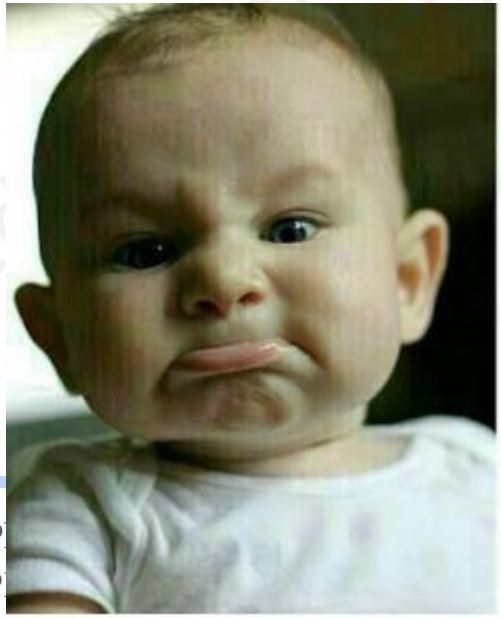
2012

Only 30% of projects meet/exceed their cost and schedule goals



Only 30% of projects meet or exceed their cost and schedule goals

In General Project Delivery has a 70%+ Failure Rate



ذکر مطالب فوق تنها در صور

Sutter Health

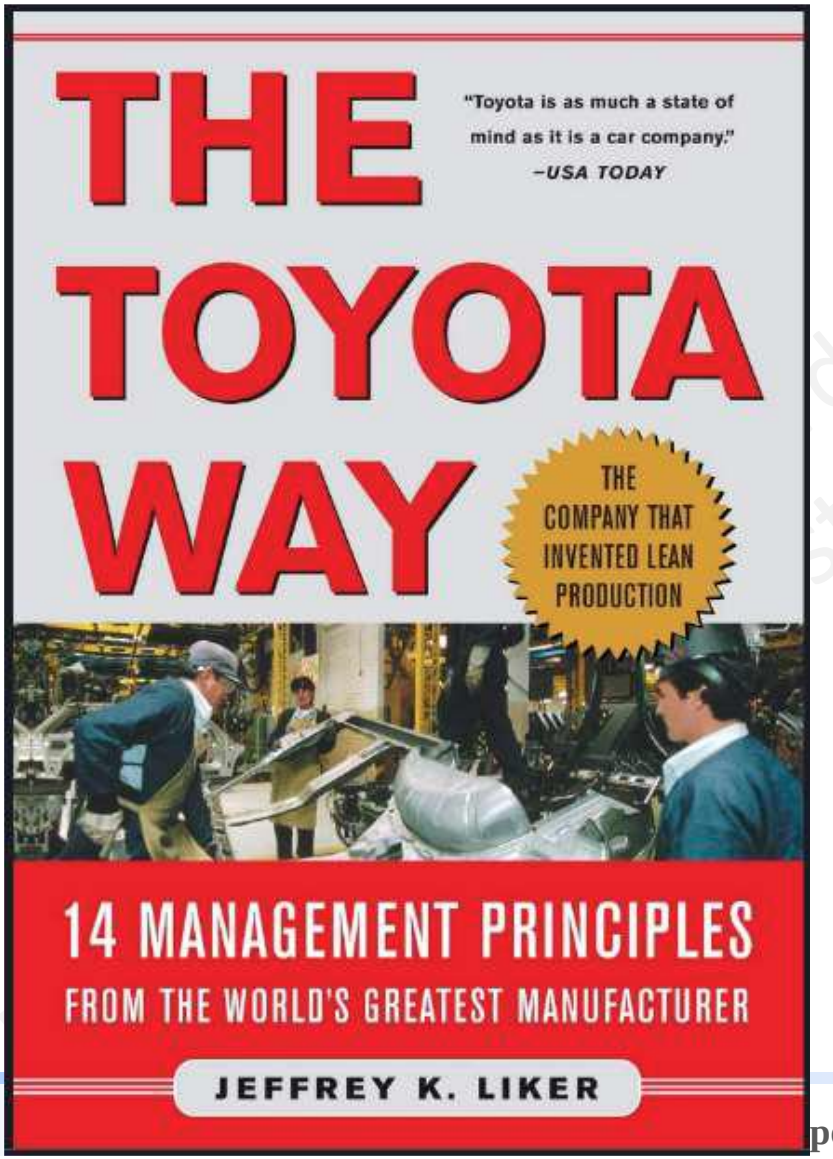
- So what is the track record at Sutter Health?

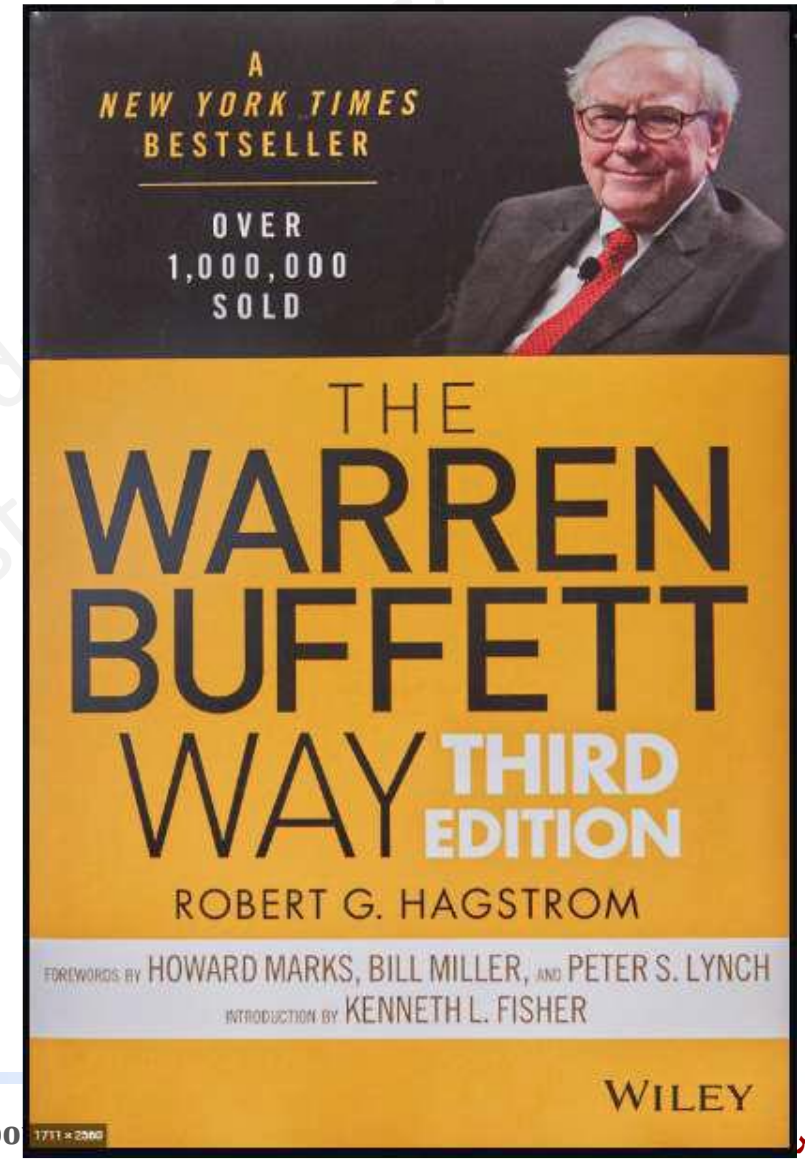
Sutter Health vs. The World

The World of Project Delivery has a 70% Failure Rate

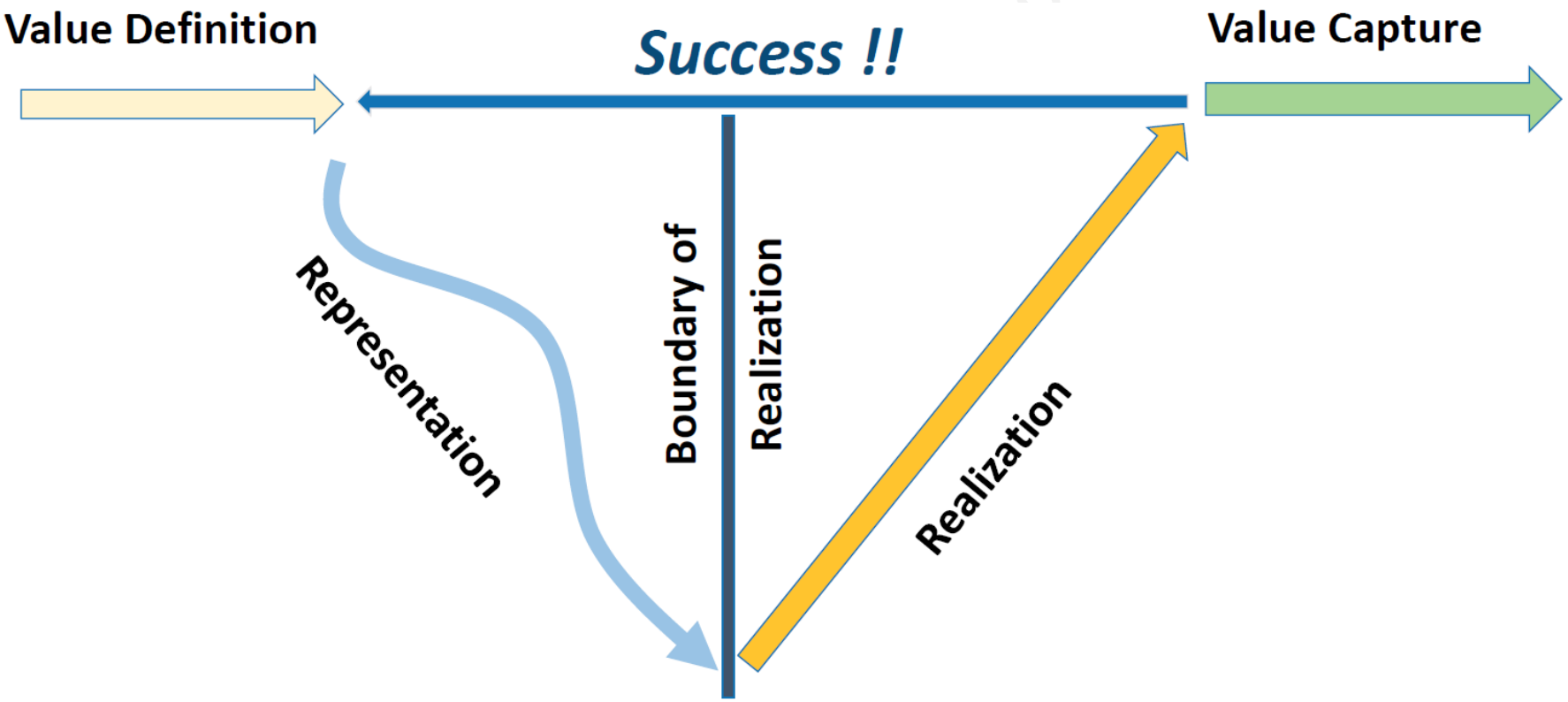
Sutter Health has a 92% Success Rate

The Sutter Way

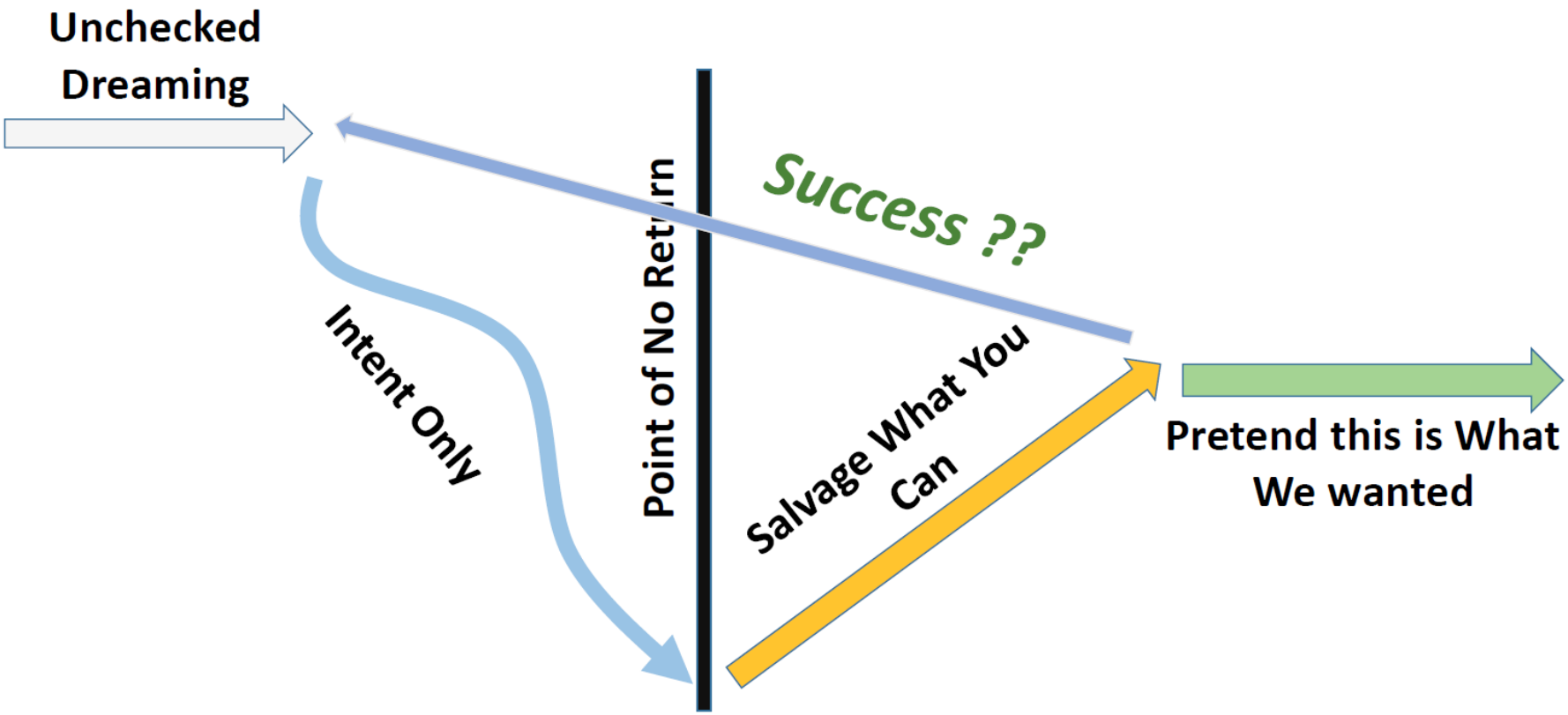




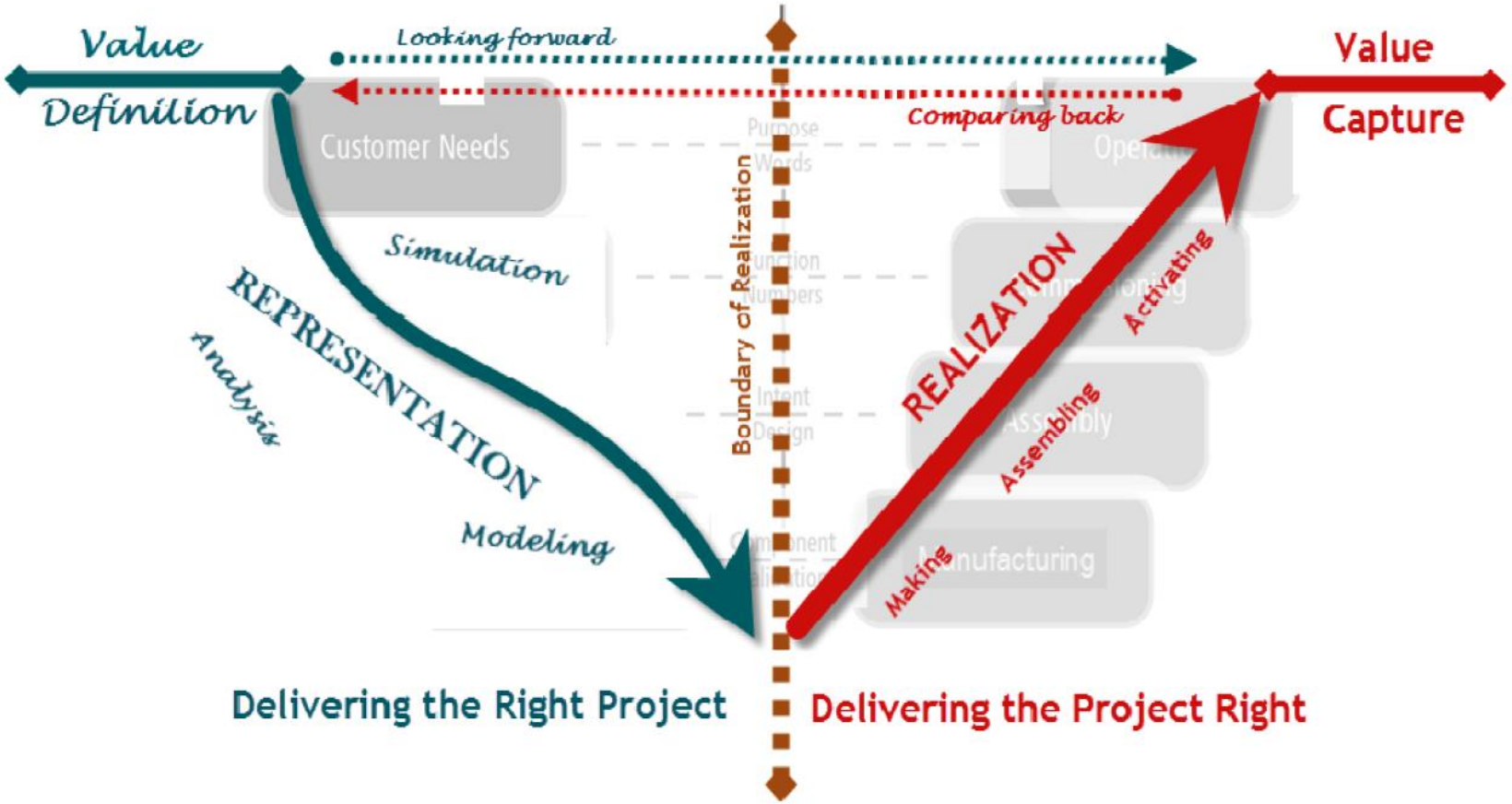
4 Phases of Value Delivery



Reality

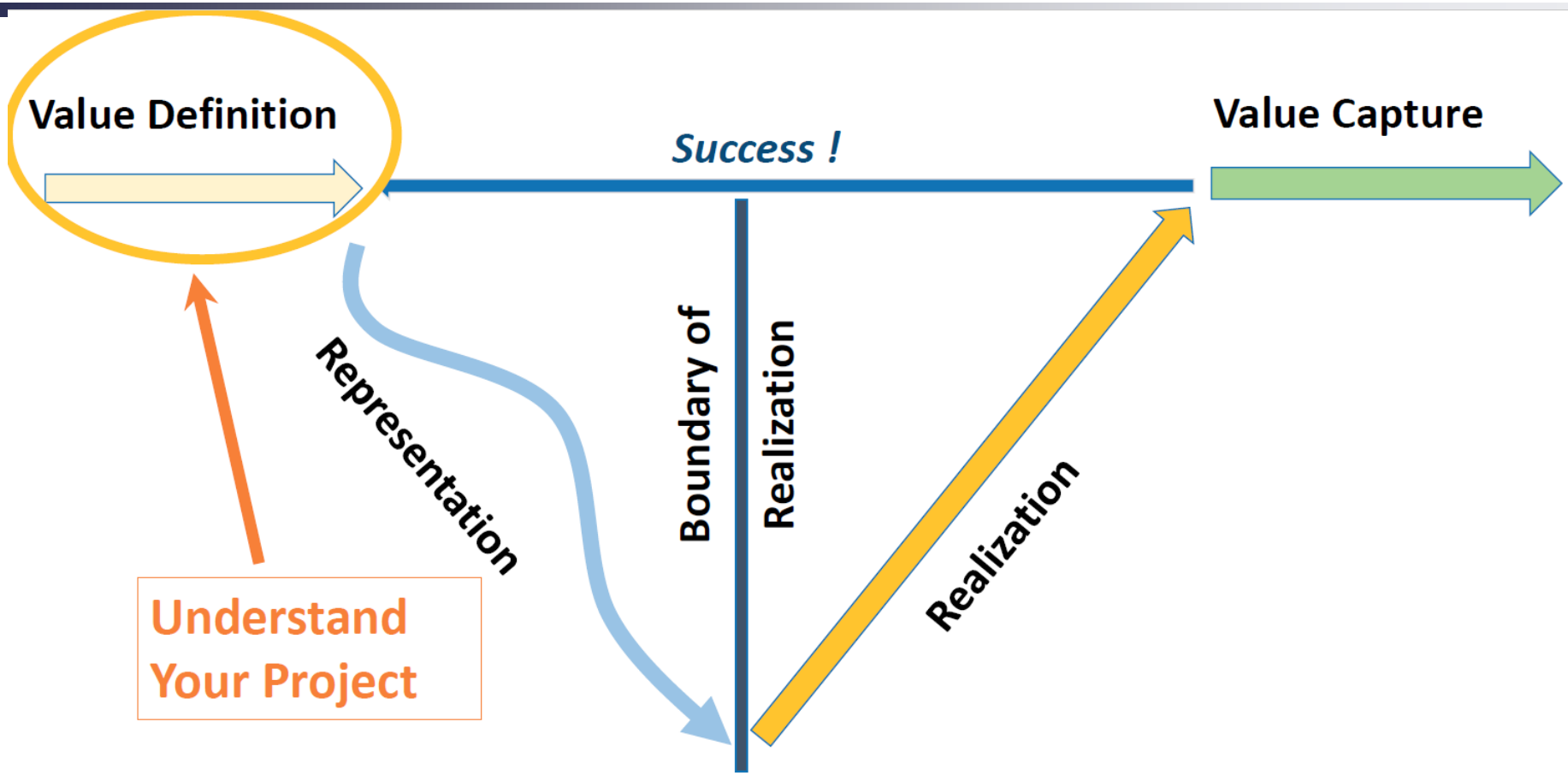

Unchecked Dreaming
Success ??
Intent Only
Point of No Return
Salvage What You Can
Pretend this is What We wanted

4 Phases of Value Delivery

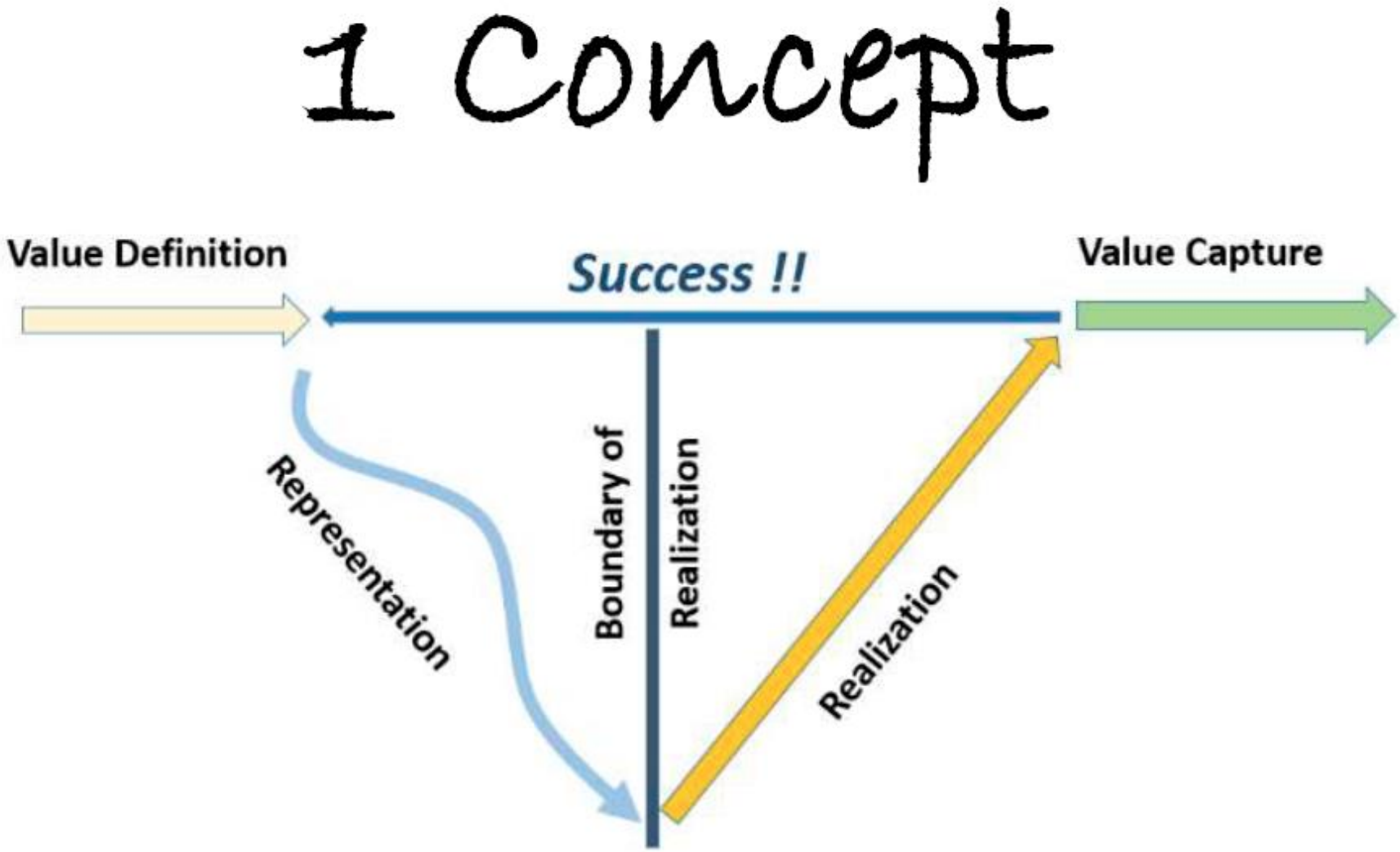


From the paper: "4 Phase Project Delivery & the Pathway to Perfection"

4 Phases of Value Delivery



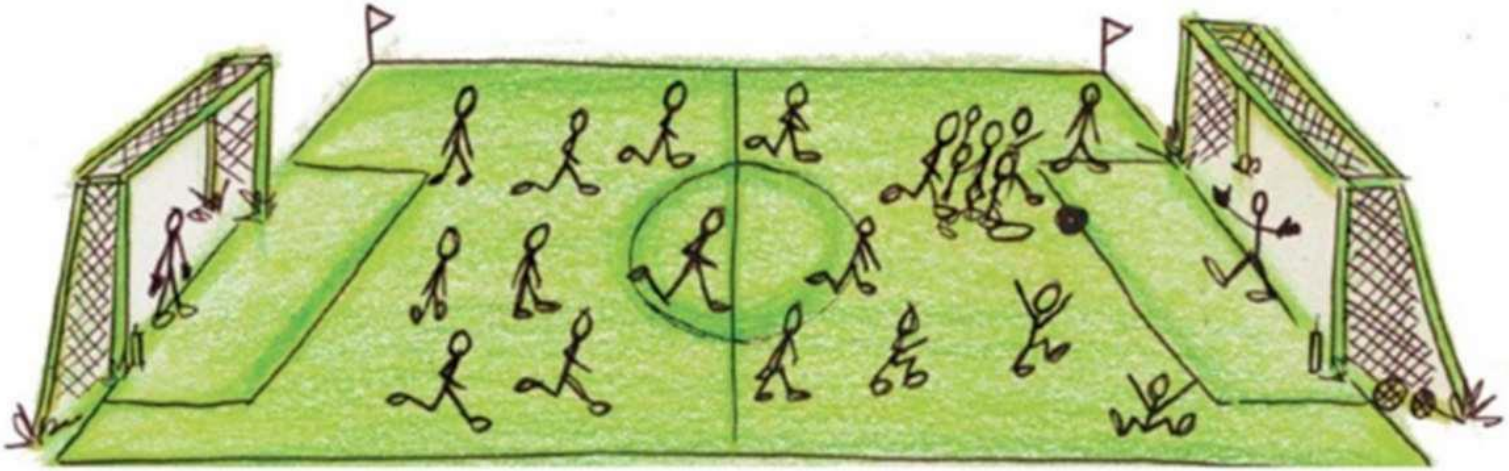
4 Phases of Value Delivery



4 Phases of Value Delivery

2 Principles

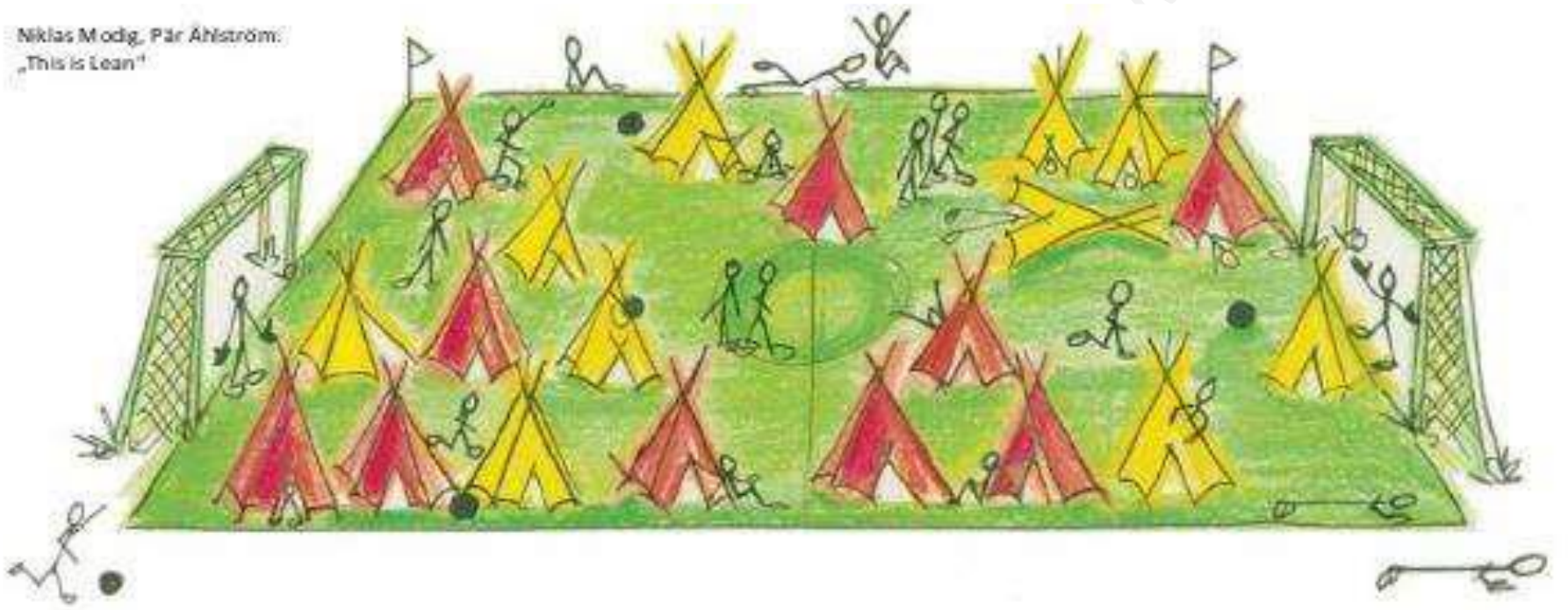
What are the two pre-requisites for a successful game of football?



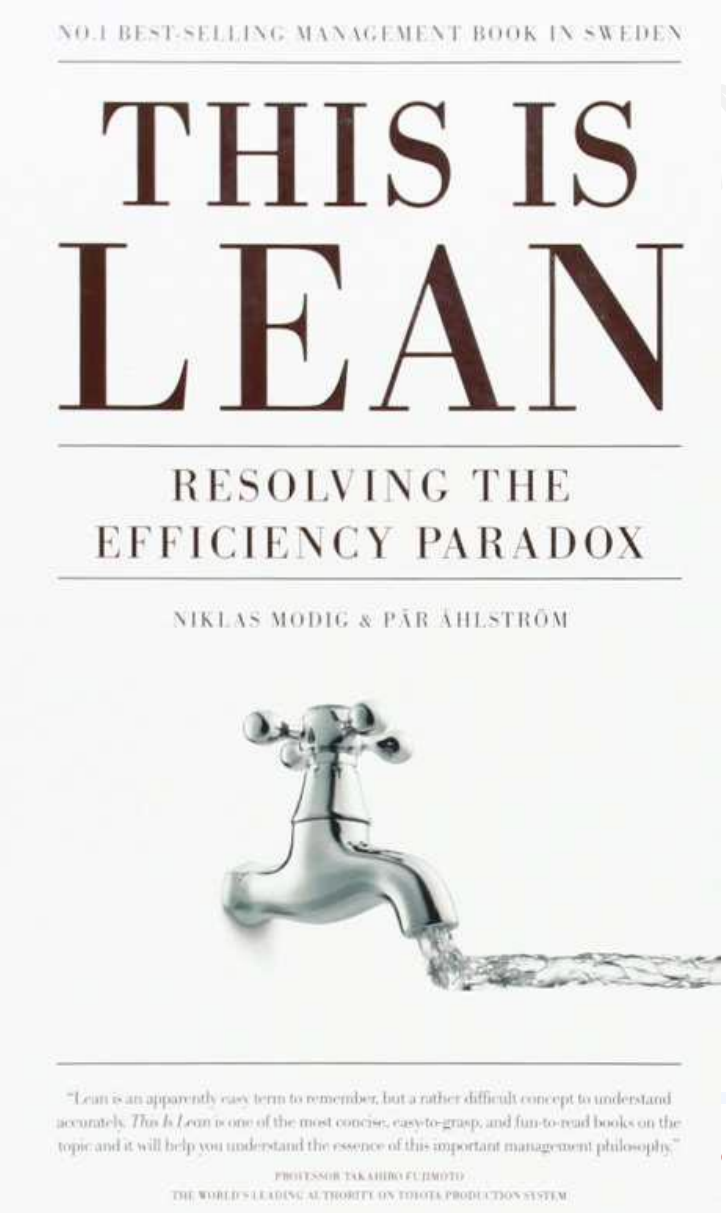
Everyone can see the whole pitch all the time

Everyone is abiding by the same set of rules

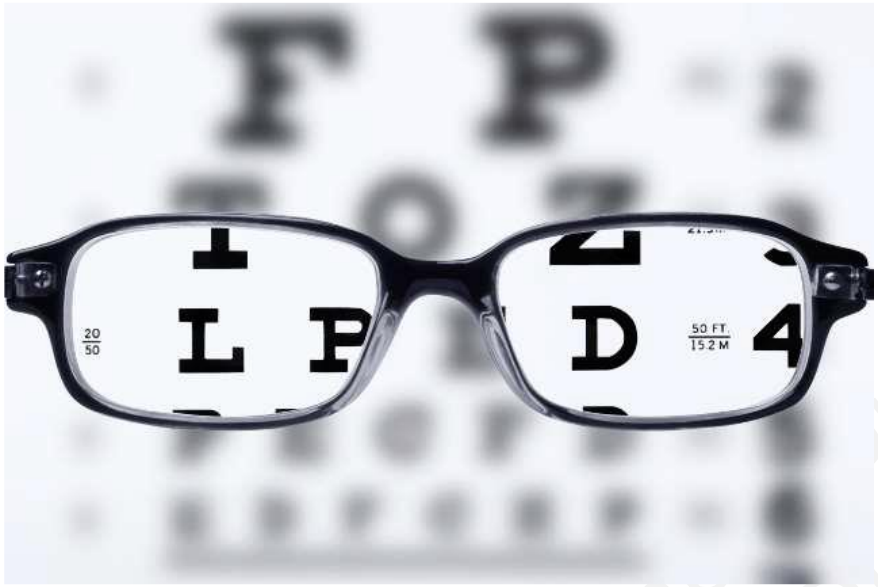
4 Phases of Value Delivery

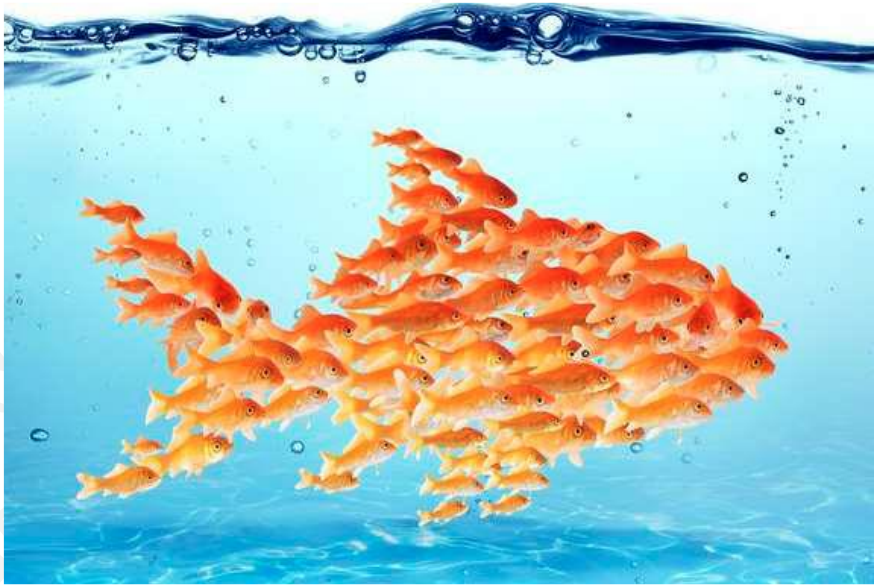


4 Phases of Value Delivery



4 Phases of Value Delivery





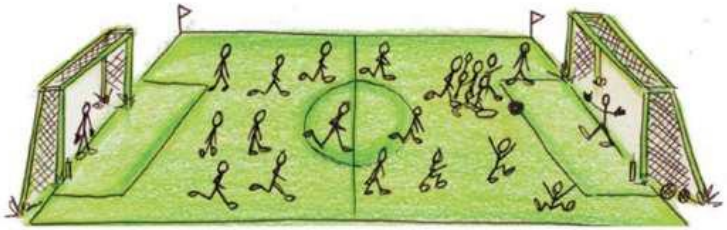
CLARITY ALIGNMENT

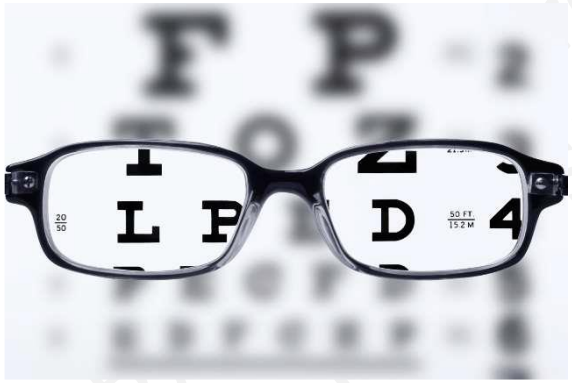
What the Rules are
What Winning is

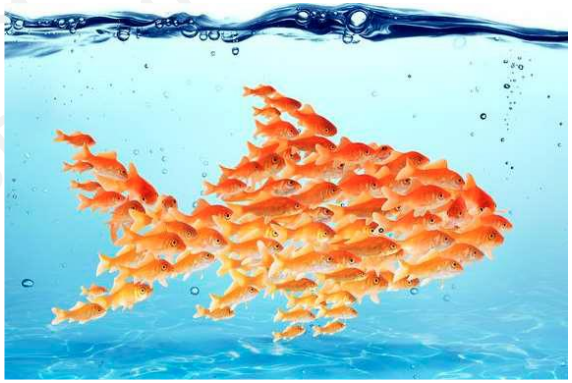
ALIGNMENT

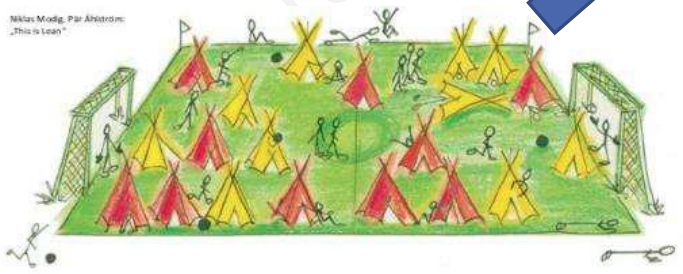
Same Rules
Same Winning

4 Phases of Value Delivery

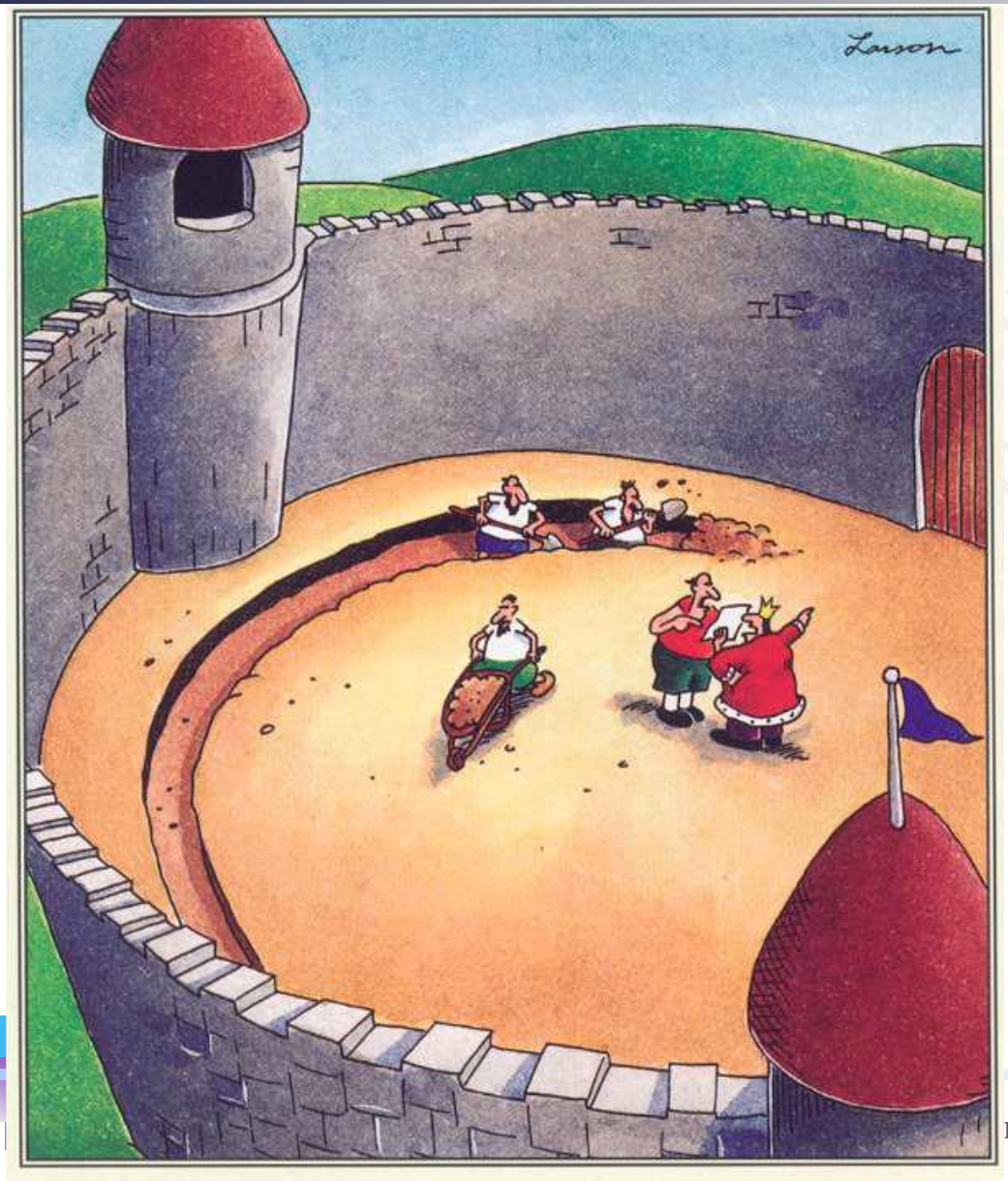






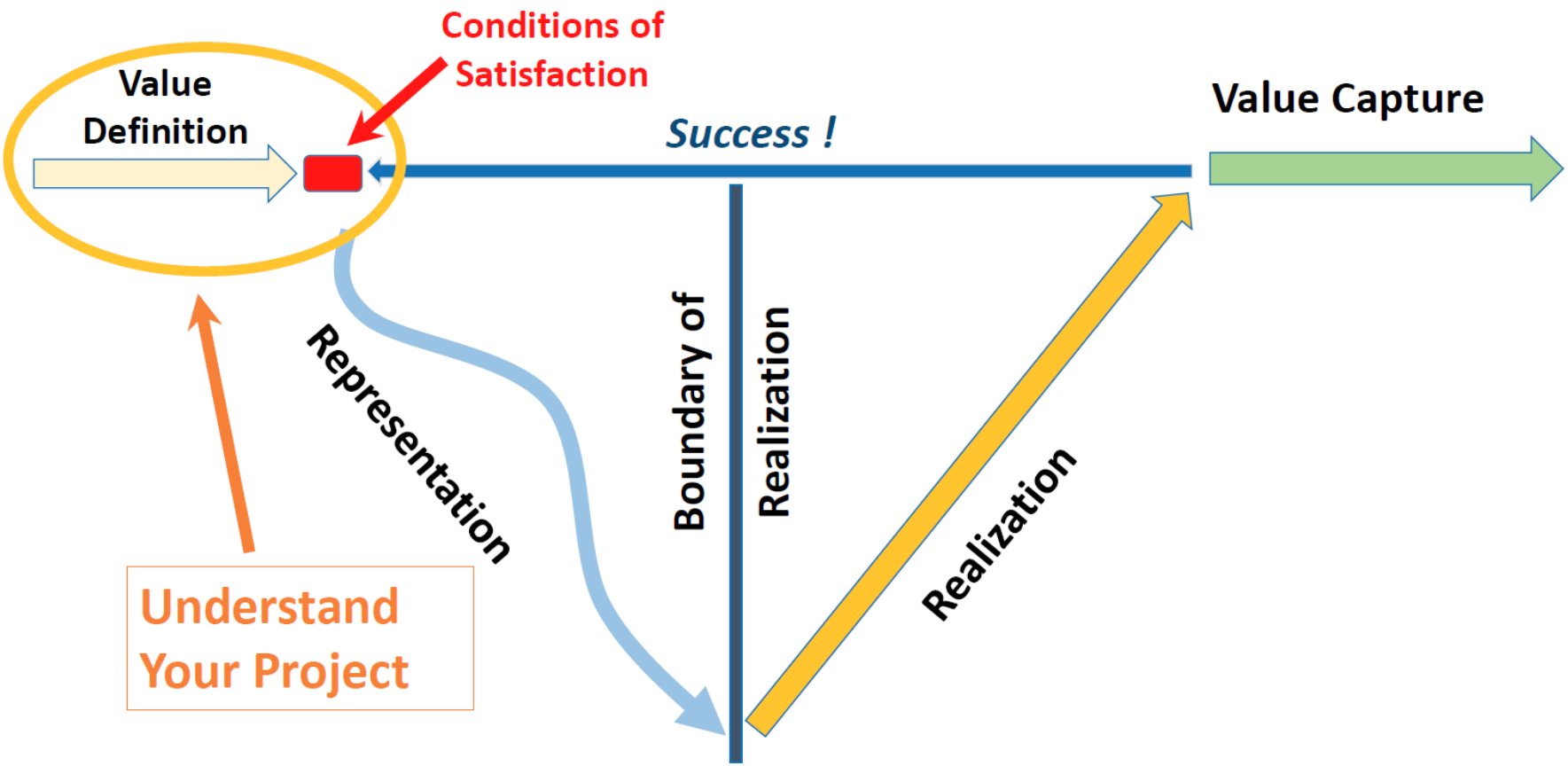


Key Method 1 Understand Your Project



Suddenly, a heated exchange took place between the king and the moat contractor

Key Method 1 Understand Your Project



Key Method 1 Understand Your Project

Value Definition	Conditions of Satisfaction
Stakeholders What They Are Trying to Achieve And Why	Scope Required Time Available Money Available Anything Else Important

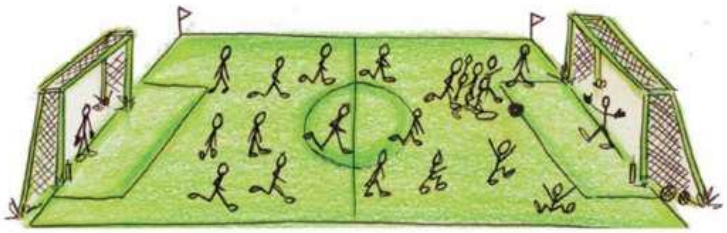
Key Method 1 Understand Your Project

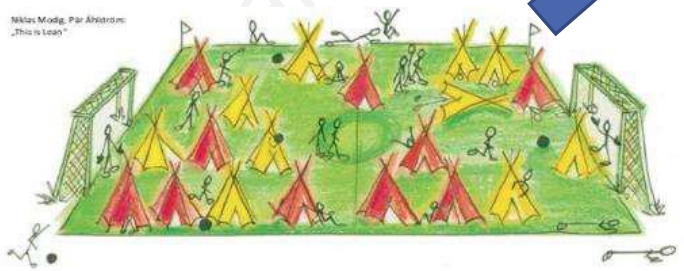
Value Definition	Conditions of Satisfaction
Elders of a coastal town No more sailors dying in shipwrecks off coastline Need more trade and tourism	A lighthouse that will operate for 100 years Be open and working within 1 year of today Cost less than 1,000 gold Pieces Have a light that's visible from 100 miles away

Key Method 1 Understand Your Project

Key Method 2: Smart Business Deal

Companies Follow the Money





The Stagnation Equation

Performance is terrible (70% Failure Rate)

+

Everyone is making money

(Rare Arch. & GC Bankruptcies) **= Nothing Changes**

+

Owners aren't paying attention

The Realization Equation

Performance is terrible

+

We might not make any money

+

Owner is paying attention

= Everything Changes

The Deal Pt. 1: Shared Risk / Reward

Single Goal: Meet the Owner's Conditions of Satisfaction

Cost of Work Guaranteed

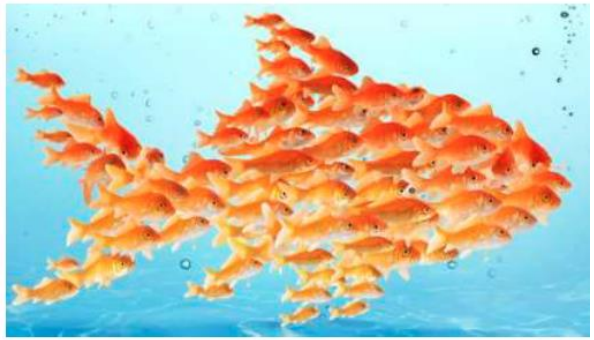
Fixed Overhead Guaranteed

X% Share of Savings

Architect & Designers

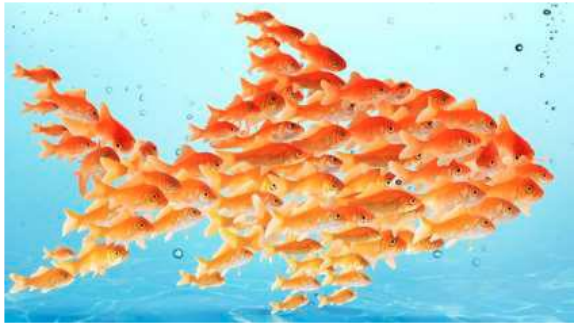
GC & Trades

100% of Profit at Risk



ALIGNMENT

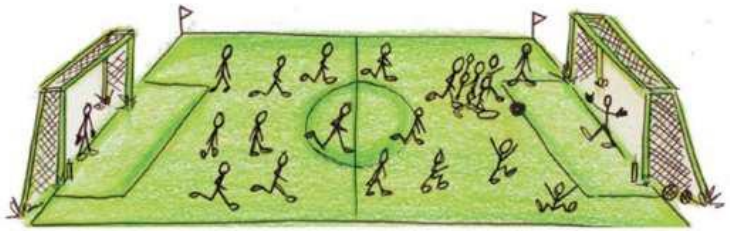
The Deal Pt. 2: Shared Governance



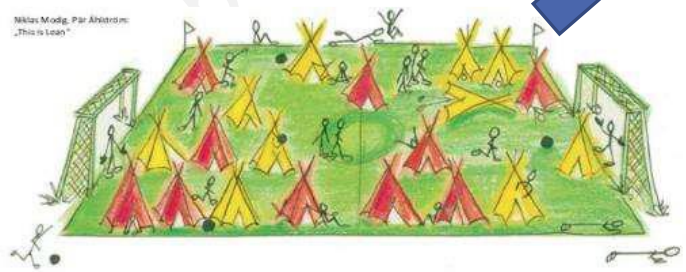
ALIGNMENT

Key Method 3: Grow Your Culture

People Follow the Culture



?



Key Method 3: Grow Your Culture

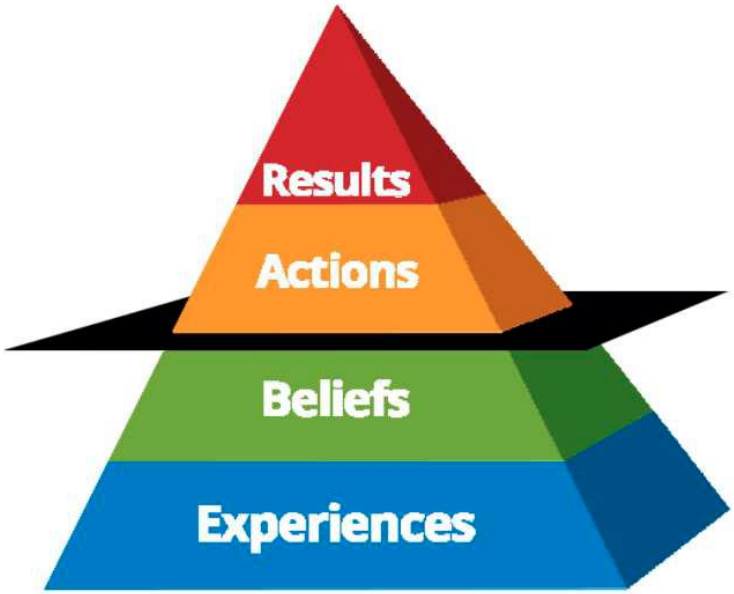
What is Culture?

It’s what happens when you’re not there

What is Culture?

- Experiences create Beliefs
- Beliefs drive Actions
- Actions produce Results

So change the experience of being on your projects



New Experiences: Psychologically Safe Spaces

- Team members see each other as individuals not categories
- Help & respect is freely given and received
- People can & do say what's on their mind
- People respectfully challenge one another
- Passion is welcome
- Breakdowns in the safety of the space are quickly acknowledged and corrected

Retrospectives

- Retrospectives are structured, reflective events that enable a project team to have a common understanding of their project experience. It represents the “Check” element of the PDCA cycle and prepares the team for new action for continuous improvement.
- For both lean and traditional projects, Post Occupancy Evaluation (POE) is discussed as a means of learning those lessons that are only available after the completion of a project or facility

Retrospectives

- Both retrospectives and Post Occupancy Evaluation (POE) provide excellent feedback on the conduct of projects. This information is very helpful to project teams and other stakeholders in providing a learning experience that promotes improvements in the conduct of projects in the next cycle of operations.

There is one major difference between POE and Retrospectives, and it is the timing of these events

- **POE** by its very definition is conducted after a facility has been turned over to the owner at the completion of a project. It provides highly valuable learning lessons on large scale issues that can influence a subsequent project, but unfortunately corrective action at that point would be inordinately expensive or simply impossible.

Retrospectives

- **Retrospectives,** on the other hand may be conducted at any time during a project and allow the benefit of lessons learned to be used while the project is still in progress.
    1. A quick format – at the end of each meeting; these are usually held as plus deltas
    2. Regularly occurring activities, such as every three weeks, or at the end of work cycles
    3. Event-based activities, such as at the completion of major milestones. A major breakdown would be such an event.
- The purpose of retrospectives in reviewing a project is to determine:
    - ✓ What went well.
    - ✓ What was different from expectations.
    - ✓ What did not go well.

Retrospectives

- By using this information, a team can determine:
  - ✓ What to keep doing
  - ✓ What to stop doing
  - ✓ What to start doing
- Action steps should be listed at the end of each meeting. It is best to have a consensus on the actions to be taken, and the responsible individual(s) for each item.

Time requirements

- A Big Room would be a good environment for conducting a retrospective since it would have wall-mounted project and schedule information
- A facilitator manages the process.

New Experiences: Psychologically Safe Spaces

1. Team members see each other as individuals not categories
2. Help & respect is freely given and received
3. People can & do say what's on their mind
4. People respectfully challenge one another
5. Passion is welcome
6. Breakdowns in the safety of the space are quickly acknowledged and corrected

New Experiences: Big Rooms & Celebrations

New Experiences: Big Rooms & Celebrations

- A Big Room would be a good environment for conducting a retrospective since it would have wall-mounted project and schedule information.

A draft agenda

A. 5 minutes – an overview of the rules, followed by having attendees write things that went well on 3 by 5 cards of one color, and less successful events on the other 3 by 5 cards.

B. 10 minutes – participants brainstorm on the good and bad outcomes, writing silently on the rear of each card, then placing them on a table or white board.

C. 5 minutes – the cards are reviewed, and duplicates are grouped together.

D. 20 minutes – The facilitator helps the group to find solutions for specific “needs improvement” issues.

E. 5 minutes – the team votes on the issues to pursue promptly.

F. 5 minutes – people are assigned to follow up on specific issues.

Learning from lean construction projects

- Companies should first understand themselves before rushing out to hire a consultant to make a lean transformation.
- A lean consultant would benefit a company most by helping it to learn how to change, but a consultant is “always an outsider” and the people in the company must take the initiative to bring about change.

The importance of Conditions of Satisfaction

- By definition, the Conditions of Satisfaction are a set of criteria or expectations that specify how the success of a project will be determined.
- As a project progresses many events may occur and people can easily lose sight of what different parties are expected to do, and what they expect Learning from projects and enhancing 437 others to provide to them.
- The Conditions of Satisfaction outline the success factors and the expected behaviors that are essential for the implementation of a successful lean project.

The importance of Conditions of Satisfaction

- The owner's Conditions of Satisfaction would emphasize the owner's priorities, but overall, the project team should mutually agree on the Conditions of Satisfaction .
- They promise to commit to the principles and practices of lean project delivery as outlined in a reference guide – in this example "LPD 101 Lean Project Fundamental Guide".

The importance of Conditions of Satisfaction

- Examples of project success as viewed by the team are:
  - Everyone is profitable
  - The project is delivered to the mutually agreed Target Cost
  - The project is delivered to meet a mutually agreed schedule
  - All team leaders will have excellent knowledge of their work and their scope
  - RFIs will be only those where information is clearly missing in the documents or site conditions require resolution
  - RFIs will be issued and answered in a timely manner to avoid becoming project constraints
  - Change notices resulting from legitimate RFIs will be processed in a timely manner.
  - The overall objective will be to minimize RFI's and Change Notices
  - There will be exceptional teamwork, and minimal rework due to poor quality work
  - All schedules will be developed and executed using the Last Planner® System

Recommendations from lean projects

- **Procedural recommendations**

- Ed Anderson, of Lean Implementation Services of Florida has several recommendations on procedural issues in his publication Lean Planning and Production Control (LPPC): Tips, Tricks, & Lessons-Learned, Rev.Feb. 2018, V24.

  - Ed stresses the importance of the Big Room – he views it as an investment. For a construction site it should be at least a double wide unit and it should be equipped with dry-erase boards, communications systems and restroom and other amenities.
  - Breakout rooms facilitate small meetings to resolve issues without slowing down the main meeting.
  - Stakeholders should attend every meeting, without exception. Even if stakeholders are traveling they should be in contact with the big room and be able to participate.

Recommendations from lean projects

- **Procedural recommendations**
  - Lean stakeholders need to see reliability as a 2 way street. If a CM or owner wants specialty subcontractors to be reliable, then he or she must be reliable as well.
  - Superintendents must buy in to the lean process and the Last Planner® System – unless they buy in the plans may not be viable.
  - Ed sees the communication from sticky notes as true information. To be meaningful and actionable, commitments must be in writing, and the sticky notes accomplish that requirement.

Recommendations from lean projects

- **Procedural recommendations**
  - Ed observes a major hurdle that has to be overcome with Superintendents, and that is the question of “pushing for reliability”.
  - Every task and constraint must have an explicit owner. These responsibilities must be assigned in writing. “If everyone is responsible, then no-one is responsible”.
  - Ed proposes an innovation to replace the Sticky Note process. It is the NxtNote system, a web-based technology that generates printed sticky notes.
  - If safety problems persist after the Last Planner® System has been implemented, Ed views their occurrence as an indication that the LPS is not being implemented correctly.

Recommendations from lean projects

- **Training experiences**
- The feedback from successful lean programs and practitioners confirms that workshops are most effective for getting projects started on the right footing.

Recommendations from lean projects

- **Training experiences**

- Workshops typically includes:
  - various games and simulations, such as the “Airplane Game”
  - Such a workshop explores a number of key questions and covers several important topics relating to lean concepts

    While educational content is presented, it is a prelude to several other questions pertaining to how the project team will function.

  - Examples of such questions are:
    - How can we develop a lean mindset? What general learning do people need?
    - What are the different processes involved? It is important to give everyone a base knowledge of lean to prepare them for working as a lean organization.
    - What will provide the highest value to the entire team? How do we organize as a team?

Recommendations from lean projects

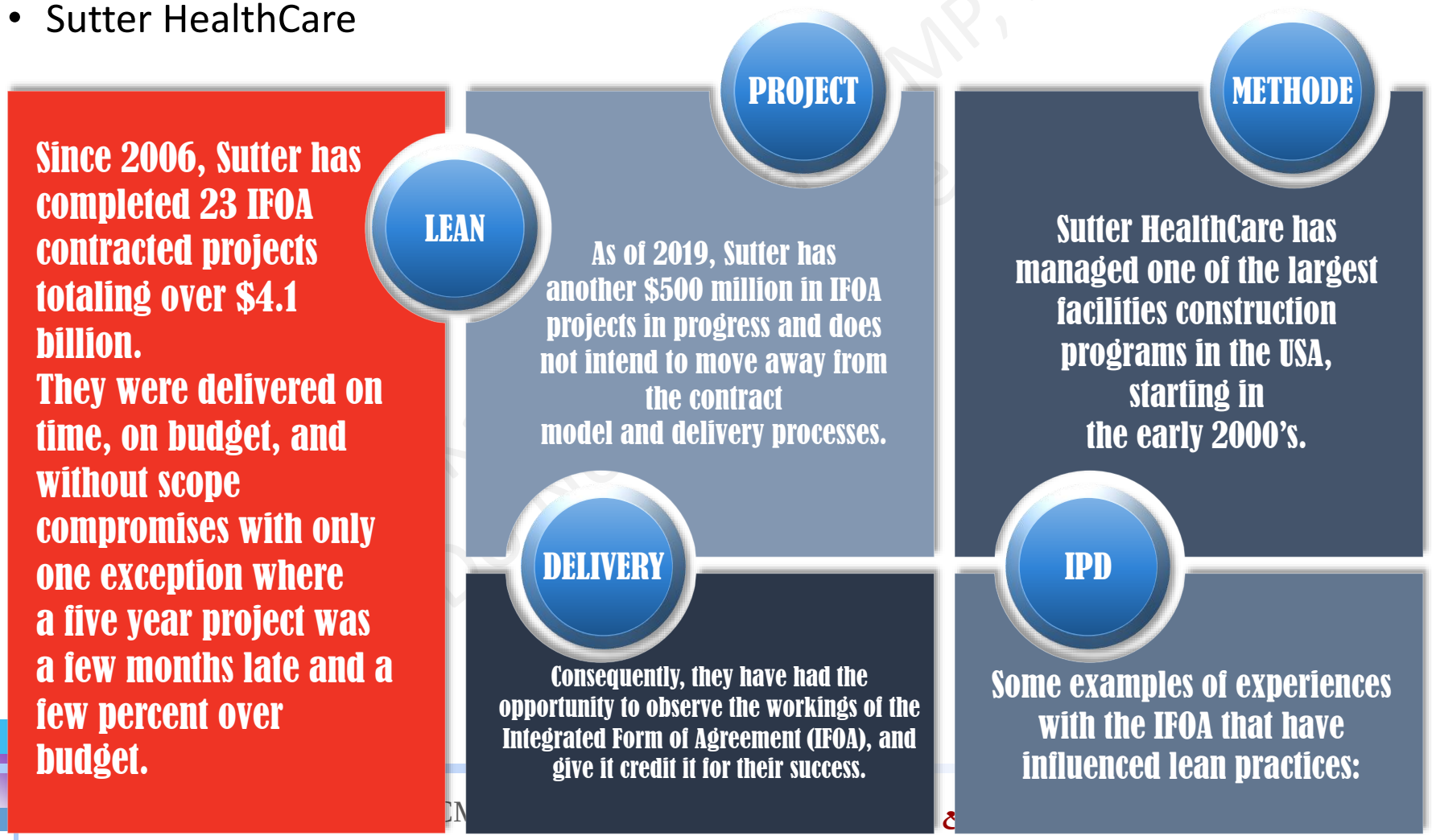
- **Training experiences**
- A goal setting exercise with the project team also focuses stakeholders on the team's priorities. This approach has worked with many of DPR Construction's lean projects.
- Usually, a Lean Specialist demonstrates pull planning to a superintendent or project manager (PM) on an actual project in three ways:
  - first, by facilitating a pull plan in front of the superintendent or PM;
  - second, by co-facilitating a pull plan with the same superintendent or PM; and
  - third, by observing the superintendent or PM administer a pull plan on his or her own.
- The results of this initiative have been outstanding – traditional projects have been delivered early, and on budget or less.

Recommendations from lean projects

- **Training experiences**
- Sutter Healthcare has determined that the training of project teams as well as in-house staff is highly beneficial to their construction program.
- One day per month is reserved for staff training, although it is primarily process-driven.
- Digby Christion, Director of Integrated Lean Project Delivery, has coordinated in-house resources for IPD best practices but utilizes LCI meetings and conferences for training on the Last Planner® System and Target Value Design. Sutter also often hires consultants to get new project teams started.
- The majority of lean training is hands-on at the project level. In particular, Last Planner training and education are done at the start of projects, including the design and construction partners.

Recommendations from lean projects

- **Project lessons**
- Sutter HealthCare



Recommendations from lean projects

- **Project lessons**

1. Limited grounds for change orders, only allowing them for: owner changes, unanticipated changes in the law, unanticipated decisions by authorities having jurisdiction, and unexpected discovered conditions.

2. Prefabrication can greatly improve project efficiency – most of the walls (about 90%) on the 3rd and 4th floors were pre-assembled offsite.

Recommendations from lean projects

- **Project lessons**

3. Because of the accuracy of the information and the use of offsite pre-assembly, on-site productivity increased, quality improved, and overall onsite material waste was reduced.

The framing contractor's productivity doubled compared to the on-site construction baseline; there was less than 1% material waste compared to 15–20% when stick building the same types of wall.

Recommendations from lean projects

- **Project lessons**

4. Steel detailing for interior spaces was greatly improved through the use of 3D visualization

Recommendations from lean projects

- **Project lessons**

5. The results were very positive. The entire structure was erected with fewer than 130 RFIs relating to steel design – far fewer than comparable projects. The IPD team realized $1.5 million in savings related to the steel due to labor savings and reduced rework.

Recommendations from lean projects

- **Project lessons**

6. IPD allows teams to identify waste across the supply chain, while they are working on the project, and to be able to take corrective action. These projects set the stage well for the projects that followed later.

Recommendations from lean projects

- **Project lessons**

7. With regard to information technology, when BIM and lean are implemented there are significant benefits as compared to conventional approaches.

Impact of lean on construction projects

- **JE Dunn's project experience reinforces the fact that much can be accomplished with the lean methodology, even in situations where there is no formal requirement for a lean contract, such as an integrated form of agreement.**
- They credit Lean practices implemented by the project teams for the significant schedule savings, along with savings returned to each owner.
- Pull planning sessions were held 2–4 weeks before planned activities. Sessions involved trade partners' personnel that were actually performing the work.
- Together and with JE Dunn, they created a plan not only effective for themselves, but also for all trade partners involved in the specific scope.

Impact of lean on construction projects

- **Other major impacts that directly benefited the project include:**

Expedited Schedule Skyloft saved a month on the schedule, allowing the owner to stock the building and hire the facility manager earlier. Aspen West saved two months on schedule with similar opportunities.

Budget Savings Both projects were completed under budget, resulting in a net savings to the owner.

Impact of lean on construction projects

- Both project teams aggressively managed the change order process. As a result, change orders were limited to unforeseen issues at Aspen West and zero change orders for Skyloft.
- Yet another project, the HT Residence Halls Renovation project succeeded because of JE Dunn's commitment to Lean principles.
- The team has seen the Last Planner system in action, can verify its positive impact to a project and is excited to tell the story so others can experience the same benefits.

Specific actions to support the lean concept

- JE Dunn provided a lean specialist for training, coaching, and support. The Regional President of the company had established an expectation that all project teams would use the Last Planner® System.
- The lean specialist was effective in providing the needed training. The specialist role is sometimes rotated through different staff members in order to maintain continuity, and could be a good model for other companies to consider.

Learning from green initiatives

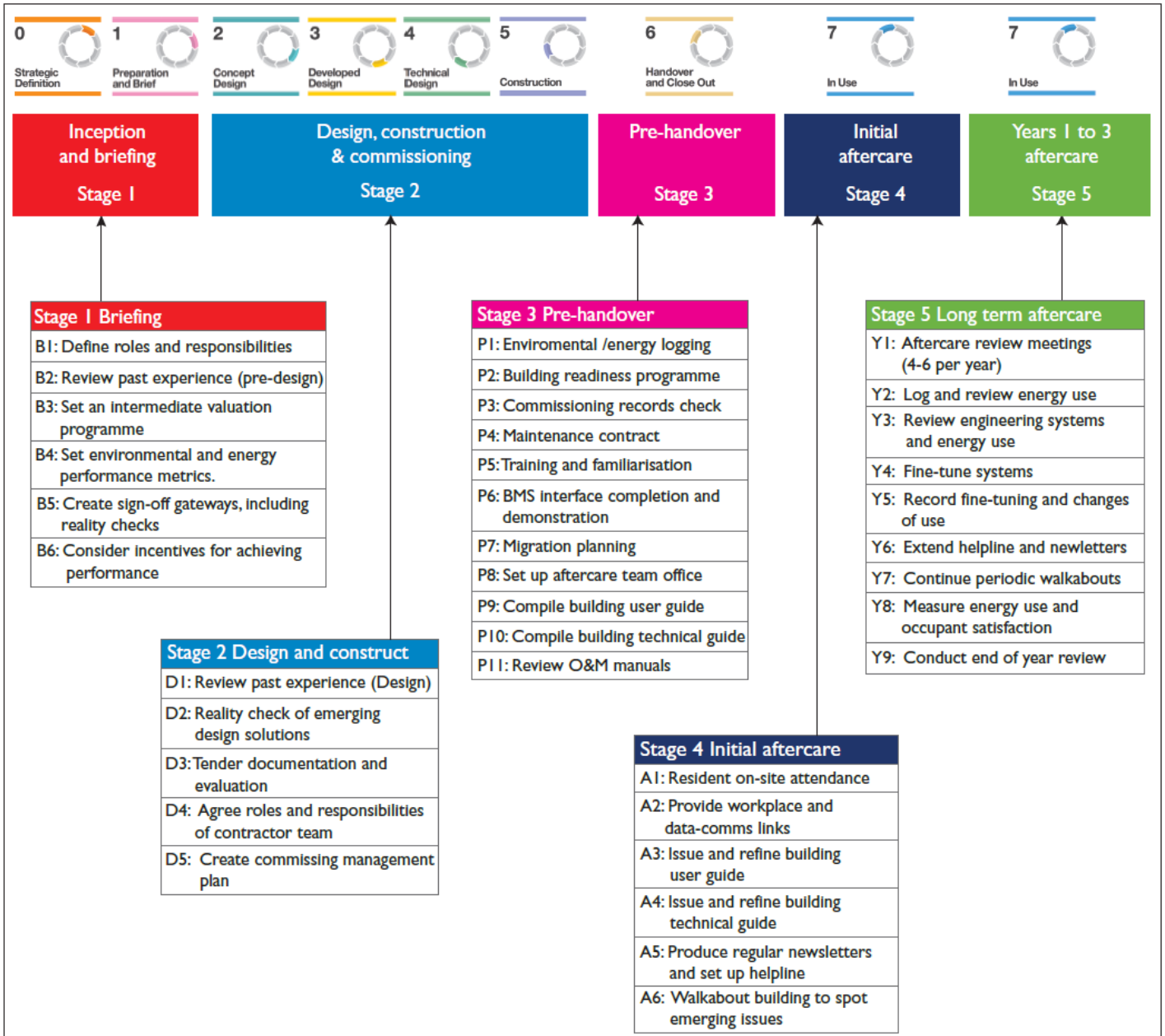
- With regard to “green” approaches to construction, the renovation project at Michigan State University clearly indicated that such projects can be built with the IPD method and deliver the “triple bottom line” that Glenn Ballard has referenced.
- Not only was the benefit of environmental sustainability obtained, but initial costs were lowered and the schedule reduced by the lean methodology.
- The completed project exemplified a successful Lean and LEED GOLD project, driven by a knowledgeable owner. It was the first IPD project carried out at a public university in the entire United States.
- Although owners drive the design and construction process, the OAEC community should give serious thought to the lessons taught by this project in light of all the concern about the state of the environment.

Post-occupancy evaluation (POE)

- **What is POE**

"... the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time“

Post-occupancy evaluation (POE)



POE Timeframe

Post-occupancy evaluation (POE)

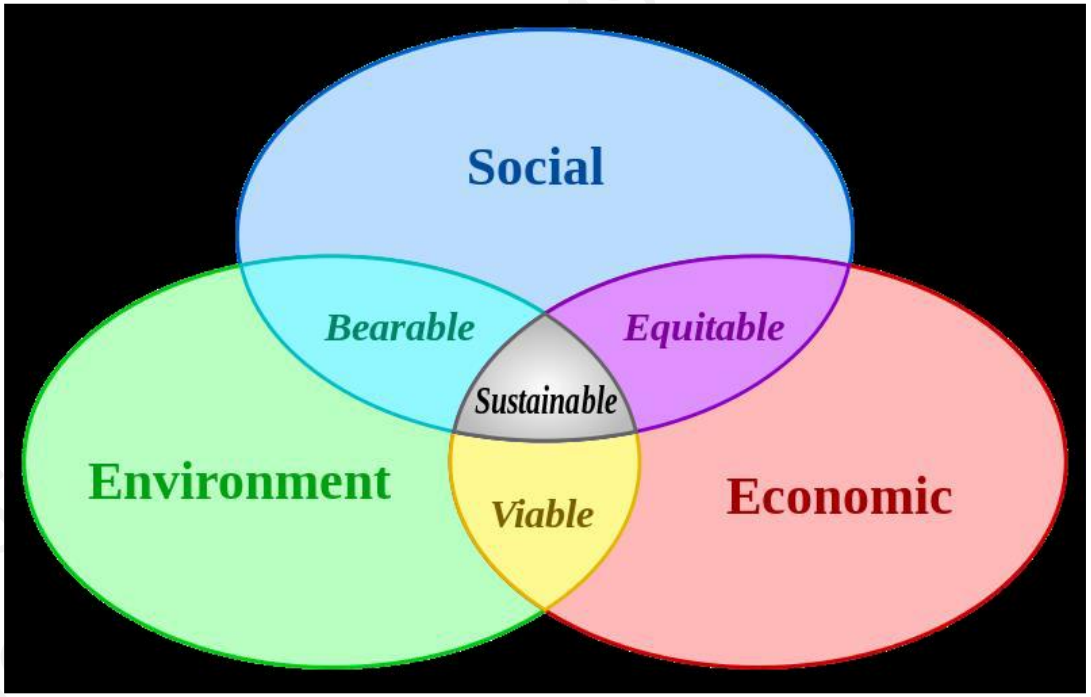
Initial Aftercare (0-6 months after occupancy, within the first 12 months)	Long term Aftercare and POE (12-36 months after occupancy)
• Fine tuning • Checking and getting all the metering to work properly • Checking the energy and environmental data • Informing any seasonal commissioning activities	• Conducting review meetings • Assessing the operational performance of the building against the design metrics • Assessing how well the building meets the client/end users' needs • Additional fine tuning (if needed)

POE Timeframe

POE Metrics

Specific and clear
Measurable
Achievable
Realistic
Timely

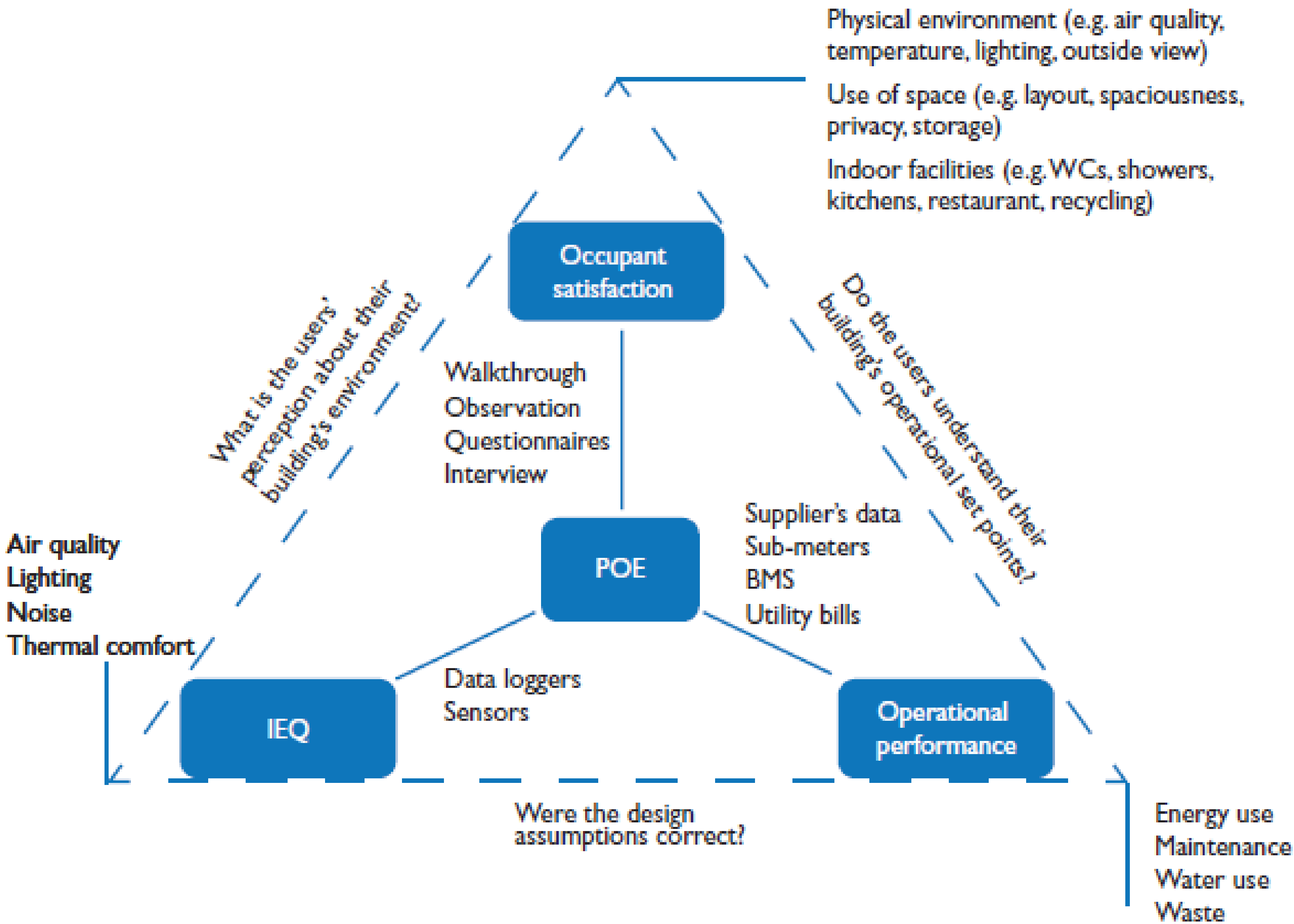
Examples:
Economic: capital cost, operational cost
Environmental: electricity, fossil fuels, water, waste, emissions
Social: occupant satisfaction, IEQ factors



POE Methods

AUDE (Association of University Directors of Estates) guide for existing available POE methods, for example:
Design Quality Indicators

POE Methods



Physical environment (e.g. air quality, temperature, lighting, outside view)
Use of space (e.g. layout, spaciousness, privacy, storage)
Indoor facilities (e.g. WCs, showers, kitchens, restaurant, recycling)
Occupant satisfaction
What is the users' perception about their building's environment?
Do the users understand their building's operational set points?
Walkthrough
Observation
Questionnaires
Interview
POE
Supplier's data
Sub-meters
BMS
Utility bills
Air quality
Lighting
Noise
Thermal comfort
IEQ
Data loggers
Sensors
Operational performance
Were the design assumptions correct?
Energy use
Maintenance
Water use
Waste

Post-occupancy evaluation (POE)

- **Overview of post-occupancy evaluation (POE) for continuous improvement in construction**
- A POE involves the measurement of the functioning of a facility as compared with its purpose as defined in a formal program, and by the objectives of the architect/designer
- As these objectives should mirror the agreed-upon wants and needs of the client/owner, POE requires that a systematic methodology be used to compare these expectations with the effects of the facility on its users.
- The results of the POE can identify the extent to which the design intent has been met; this feedback can also help to identify “best practices” that can be used to improve future designs.

Post-occupancy evaluation (POE)

- **Overview of post-occupancy evaluation (POE) for continuous improvement in construction**
- The quality advocate, Peter Senge, in his book The Learning Organization, advocates that organizations follow a cyclical process in order to learn from their actions and use that knowledge to improve their performance.
- The experiences of world-class organizations indicate that analysis can provide invaluable information, enabling one to manage analytically, not just intuitively. In the design and construction arena, this analytical approach leads stakeholders to examine and improve the processes involved in both construction design and delivery.

Scope of evaluations

- A specific part of a facility
- An entire facility
- A building program
- Programming/design
- Construction procurement and delivery

Post-occupancy evaluation (POE)

- **Categories of POE: historical, comparative, longitudinal , and quasi-experimental**
- **Historical:** Studying the facility in retrospect to determine if actions taken during the design/construction process have been effective.
- **Comparative**: Contrasting two situations such as two similar facilities after one has been specifically changed.
- **Longitudinal:** Taking baseline measurements before changes are made. Changes are then initiated and differences attributed to them.
- **Quasi-experimental:** Using statistical approaches to compare experimental and control situations.
- **Post-mortems:** A re-visitation of the design and construction processes themselves provides critical process-related lessons.

Planning for the POE

- **A facilitator must be designated to coordinate the POE:** It is highly recommended that this facilitator should not be a member or affiliate of the design team or the construction team, in order for the POE process to be unbiased and objective.
- **A POE survey instrument is developed** to address the factors of user satisfaction, economy, function, and performance in the project/facility being reviewed. It uses a five-point Likert scale ranging from "very dissatisfied" to "very satisfied," with a midpoint indicating "neither satisfied nor dissatisfied." One version of the survey is developed for facility users (who are familiar with a facility) and another for design, construction, operations, and maintenance personnel.

Planning for the POE

- **Based on the degree of need**, a POE may be tailored to include such factors as general satisfaction, aesthetics, layout, air quality, privacy, durability of construction, maintainability of equipment, energy, and efficiency.
- A candidate facility is selected for review; ideally, it should have been occupied for between one and two years, long enough not to be distracted by short-term final adjustments by the contractor, but not so long that shortcomings become accepted as part of “living with” the facility.

POE procedures

- **Invitations are sent to the team members for two distinctly different evaluation meetings:**

A. a facility user meeting, and

B. a design/technical team meeting.

- The second group is especially critical as it is the best source of remedial action information. It is usually more convenient to have separate meetings on different occasions as the meeting agendas are somewhat different; the survey instruments, in particular, are different. The design/technical team meeting requires having team members acquainted with a facility they may be seeing for the first time, so more time has to be spent in providing guidance on the layout and features to be examined in detail.

POE procedures

I. The facilitator leads the evaluation meetings. The design/technical team is instructed on the approach needed to make building observations and complete the survey documents.

II. A general discussion is held on the background and conduct of the project. The owner's project staff and the architect/engineer (A/E) of record as well as other decision makers provide background on the inception of the project and its subsequent conduct.

III. The POE participants walk through the entire facility in small groups and individually complete the surveys.

IV. Following the site visit the data from the design/technical team's surveys are collated and analyzed.

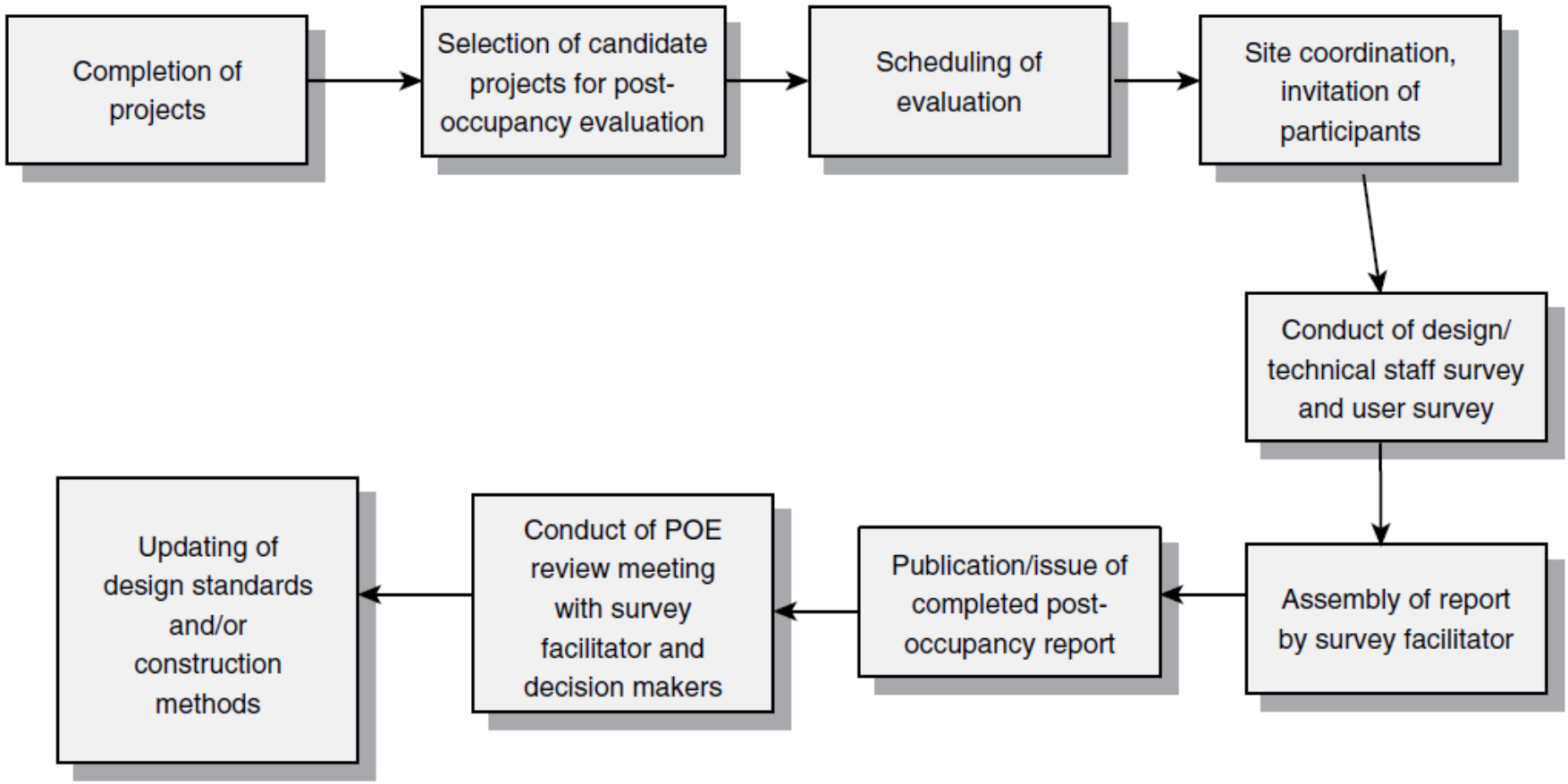
POE procedures

V. The scored and narrative responses for both users' and design/technical surveys are combined with historical building performance information. Maintenance records are checked for operating costs, breakdowns, and malfunctions.

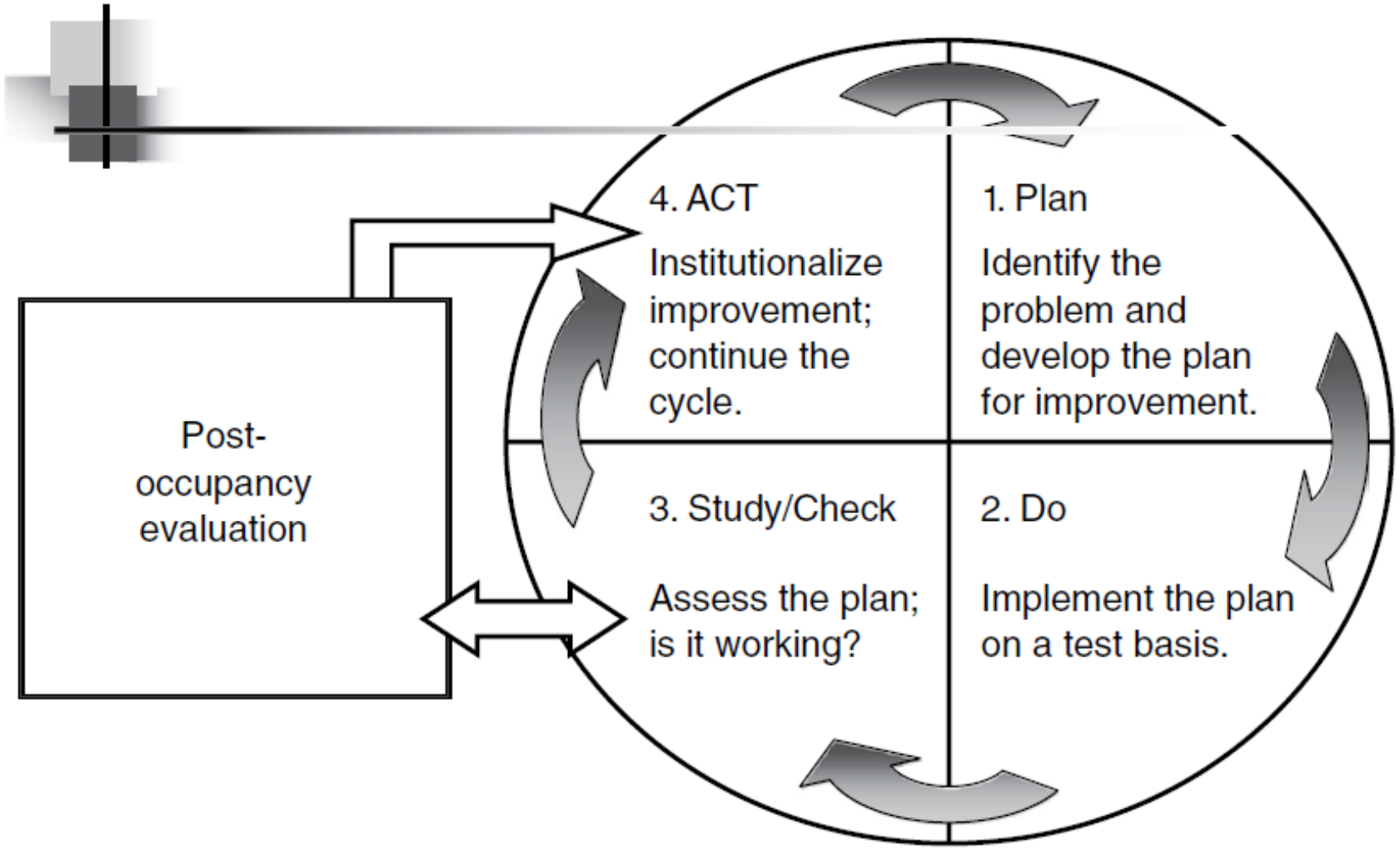
VI. A comprehensive POE report is prepared. The survey findings are reconciled with current standards and specifications to develop meaningful recommendations.

VII. The report is distributed to all involved parties.

Flowchart of the post-occupancy process



The Deming Cycle (PDSA Cycle) and POE



Quality score calculations

- $Quality\ Score(QS_k) = \frac{\sum_{j=1}^{n} R_j \times W_{jk}}{\sum_{j=1}^{n} W_{jk}}$

- Quality professionals can further enhance the POE process through life cycle analysis to assess building/ facility performance on a wider scale that includes not only user satisfaction with everyday utilization, but also issues of operating cost, durability, and reliability. User satisfaction questionnaires provide valuable information on the perceptions of the client (construction owner) with respect to the finished product and, very importantly, the nature of the associated processes.

Client satisfaction with design and construction services

- A performance evaluation questionnaire is an excellent adjunct to a POE. It addresses what is perhaps the most important part of the design and construction process;
- that is, the perceptions of the client (construction owner) with respect to the finished product and, very importantly, the nature of the associated processes.
- It goes without saying that the owner's level of satisfaction with the outcome of a project is an important measure of success.
- A typical questionnaire would address performance measures relating to such issues as timeliness, responsiveness, communication, empathy, cost, and quality.

A typical survey could address these issues as follows:

Owners

- Use the following scale to reflect how the following factors influence your satisfaction with a contractor organization. 1 = no importance to 5 = extreme importance.

1. Timeliness: Does the contractor (for miscellaneous jobs):
   a) Provide a fair estimate of cost and schedule?
   b) Give small jobs high priority?
   c) Complete jobs quickly, once they start?
   d) Respond promptly when asked for work status?

Client satisfaction with design and construction services

2. Communications: Does the contractor:
   a) Update me on jobs and their status?
   b) Explain each job before starting it?
   c) Notify me of and explain project delays?
   d) Follow up to ensure satisfactory completion?
3. Quality: Does the contractor:
   a) Emphasize the facility's performance characteristics?
   b) Strive to build in durability in the facility?
   c) Provide high quality workmanship, beyond code requirements?
   d) Treat quality as an essential element of owner satisfaction?

Best practices to derive the best results from POE

- A number of best practices will help construction stakeholders to derive the best results from the use of POE.
- Utilize the services of an experienced professional such as a lean facilitator to interface with the involved parties to ascertain the organization's information needs and develop an appropriate survey instrument (questionnaire).

The POE questionnaire should be validated to ensure that it asks the right questions and will be interpreted in a consistent manner in repeated use.

Best practices to derive the best results from POE

1. Develop an organization-wide commitment to continuous improvement. A commitment to the lean construction philosophy would be ideal for harnessing lessons learned to deliver greater value and eliminate waste.

2. Begin the journey toward adopting a new business model for facilities construction/management based on the principles of the Malcolm Baldrige National Quality Award (MBQNA) Criteria.

Best practices to derive the best results from POE

3. As a part of adopting the new business model, consider administering a self-assessment survey to staff involved with facilities design or construction.

4. Devote the resources necessary to administer or participate in the POE activity. Develop the infrastructure necessary for a successful program

Best practices to derive the best results from POE

5. Tailor the POE Program to the organization's needs; this will depend on whether your organization is an owner, architect, engineer, or contractor/builder. One size does not fit all.

6. Develop quantitative performance measures and monitor them over time. Integrate the POE with the PDSA cycle. The findings from POE become inputs to the study phase of the cycle.

7. Include the "voice of the customer" (the end user) in future projects as much as possible. Incorporate POE findings/recommendations in specifications, standards, and procedures promptly.

8. Be willing to change.

Enhancing the Lean Project Delivery System™ and IPD

- Collectively, many lessons have been learned from a number of lean projects that have been executed in recent years.
  - ✓ For example, BIM technology has become more accessible, more capable, and more affordable.
  - ✓ Sustainable construction has become a standard requirement as there is increasing interest in reducing the carbon footprint and in reducing operating costs.

Enhancing the Lean Project Delivery System™ and IPD

- Building information modeling (BIM) has been shown to enhance projects in several ways, especially when integrated with a project as early as the conceptual design phase. A Stanford study revealed improvements in a cross section of projects:
  - ✓ Up to 40% elimination of unbudgeted change
  - ✓ Cost estimation accuracy within 3%
  - ✓ Up to 80% reduction in the time needed for a cost estimate
  - ✓ Contract price savings of up to 10% through clash detection
  - ✓ Up to 7% reduction in project duration of each project team

Therefore the utilization of BIM in predesign team activities is highly cost effective.

Enhancing the Lean Project Delivery System™ and IPD

- Depending on the level of maturity of each project team, a number of specialist functions should be considered to support the design and construction professionals with lean deployment. They include:

  A. A lean facilitator: This individual provides orientation, training, measurement, and ongoing support with lean initiatives throughout the project.

  B. A sustainability/LEED professional assists designers in determining the level of certification that is feasible for a given project.

  C. An ICT/BIM manager: This professional uses information technology including BIM to support the entire design and construction process, further facilitating lean supply and prefabrication in keeping with project requirements.

  D. The commissioning agent (CxA) plays a vital role in project design, ensuring that required systems are specified appropriately. The CxA provides quality assurance by verifying that functional performance tests confirm that design conditions are met by completed construction. The CxA also confirms sustainability requirements have been met, as required by LEED and other related standards.

The importance of leadership in the lean transformation

1. Leaning your organization – the CEO's perspective

   a) Start with your leadership team. They must be the first believers. If they don't believe it, how do you expect the rest of the company to really follow?.

   b) Assign someone as your lean implementation manager to the primary learning and training role.

   c) Develop the mindset to use lean tools effectively I think there are two primary aspects to lean

      i. True lean, "the Toyota Way" (the way you learn to think differently) we went to a consultant for this.

      ii. Lean tools and applications for construction. – LCI has resources on these for its members.

The importance of leadership in the lean transformation

1. Leaning your organization – the CEO's perspective

So here are some steps we followed:

d) Develop a roll-out plan for your organization – we called it a lean road map

e) Abolish the word change – use the word improve

f) Plan and manage the improvement – there will be no other shift in your organization as big as this

g) Invest in training. Don't dabble, invest – time, money, energy – plan for this carefully.

h) Embrace technology – it's lean

i) Do something – try something, don't be afraid to fail at it. Learn from it, improve from it. Do it better next time.

j) Seek out resources – others have been doing lean longer and successfully – find them and, learn from them.

The importance of leadership in the lean transformation

2. Sustaining lean construction

James Womack, co-author of The Machine That Changed the World (1990), is one of the great influences in today's lean movement. The most frequent cause is that of middle management resistance to change. Womack thinks that the root cause of that problem has two factors:

- ✓ Confusion in the organization about priorities
- ✓ The failure to make someone responsible for the performance of each so-called value stream.

➢ Womack issues a caution that would serve the lean construction community well; Other organizations are different from Toyota and each other, hence experiments with value stream management methods are needed.

The way forward

He who would learn to fly must first learn to walk and run and climb and dance; one cannot fly into flying.

Friedrich Wilhelm Nietzsche

The way forward

- As studies have shown, various forms of waste in the construction supply chain account for as much as 30% or more of the construction dollar.
- There are many opportunities for improvement that will not only reduce construction costs and deliver value for owners, but also improve profitability for designers and constructors.
- Owners, in particular, need to recognize the superiority of lean methodologies such as lean project delivery and IPD in securing the foregoing objectives.