



2019
MONTERREY

1^{er} Congreso Anual

11 - 12 - 13 de Noviembre



Why the theoretical and philosophical foundations of

Lean count?



Lauri Koskela

- Professor of Construction and Project Management at University of Huddersfield from October 2014
- Professor of Lean Theory based Project and Production Management at University of Salford 2004 - 2014, before that at VTT Technical Research Centre of Finland
- Founding and continuously active member of the International Group for Lean Construction (<http://www.iglc.net/>)
- Has promoted the underlying theory of production, design and project management
 - Dissertation: KOSKELA, Lauri. An exploration towards a production theory and its application to construction. VTT Technical Research Centre of Finland, 2000.
- The most cited academic in lean construction; among the most cited in construction management, project management and operations management
- Director and Trustee (2010 – 2019) and Company Secretary (2018 - currently) at Lean Construction Institute – UK
- Disclosure of interests
 - Collaboration with a multitude of Finnish, Scandinavian and British companies, not active in Mexico
 - Advisor to and shareholder in Visilean Ltd, providing integrated lean Building Information Model solutions

Plan of presentation

1. Why foundations count: preliminary discussion
2. What are the foundations for Lean?
3. Case study: history of quality management
4. Conclusions



WHY FOUNDATIONS COUNT: PRELIMINARY DISCUSSION

How come that Toyota has not needed foundations?

- Toyota has been able to develop the Toyota Production System (TPS) from scratch and to continuously extend it without emphasis on explicit theories, foundations etc. – how has this been possible?
- According to Fujimoto (2007), the Toyota Production System (TPS) “emerged as the unplanned and unexpected result of ... seemingly unrelated innovations, improvements, and initiatives”
 - In other words: TPS emerged as an accumulation of countermeasures to perceived problems
- Yet, there have been guiding sources of knowledge and methods
 - External inspiration: Ford, Training Within Industry, Deming
 - Consultants, such as Shingo
 - Experimentation, trial and error
 - National culture: collectivism; uncertainty avoidance; valuing direct, personal experience; holistic thinking; visuality; acceptance of change
- Transfer of the TPS to new parties, new employees
 - Teachers, *sensei*
 - Socializing

Why foundations count – a number of reasons

1. Lean is (I claim) basically a **theoretical and philosophical innovation** – for explaining what is new and how it is different, we need to speak at the the level of theories
2. Even for practice, it is worthwhile to know the theory and philosophical aspects of lean, because they are **actionable**
3. If the foundations are not **explicit and embraced**, things may just go terribly wrong (the example of quality management)
4. There is an undercurrent of **scientism** in the West: what we cannot explain is occult and thus not serious (the example of dowsing)



Dowsing and scientism

Scientist finds UK water companies use 'magic' to find leaks

🕒 21 November 2017

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GETTY IMAGES

The process of using divining rod has been in use for hundreds of years

<https://www.bbc.com/news/uk-england-oxfordshire-42070719>

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Water companies are using divining rods to find underground pipes despite there being no scientific evidence they work, an Oxford University scientist found.

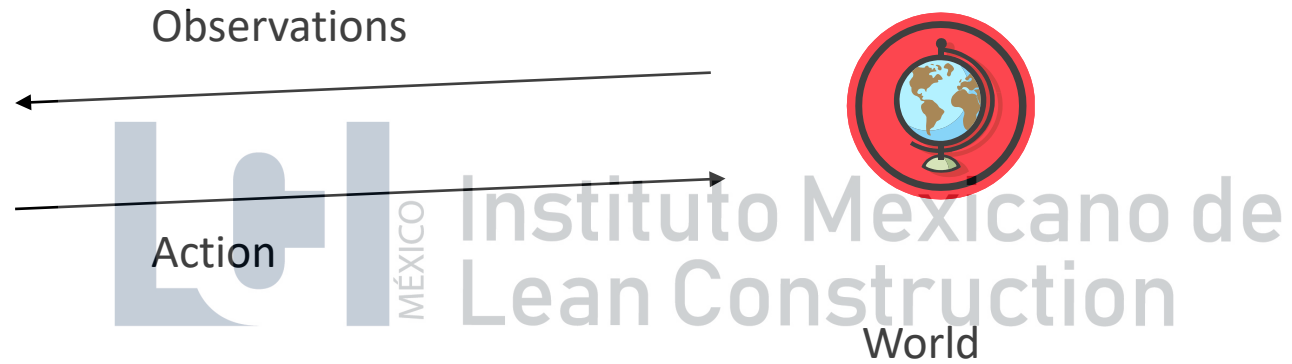
Sally Le Page said her parents were surprised when a technician used two "bent tent pegs" to find a mains pipe.

WHAT ARE THE FOUNDATIONS FOR LEAN?

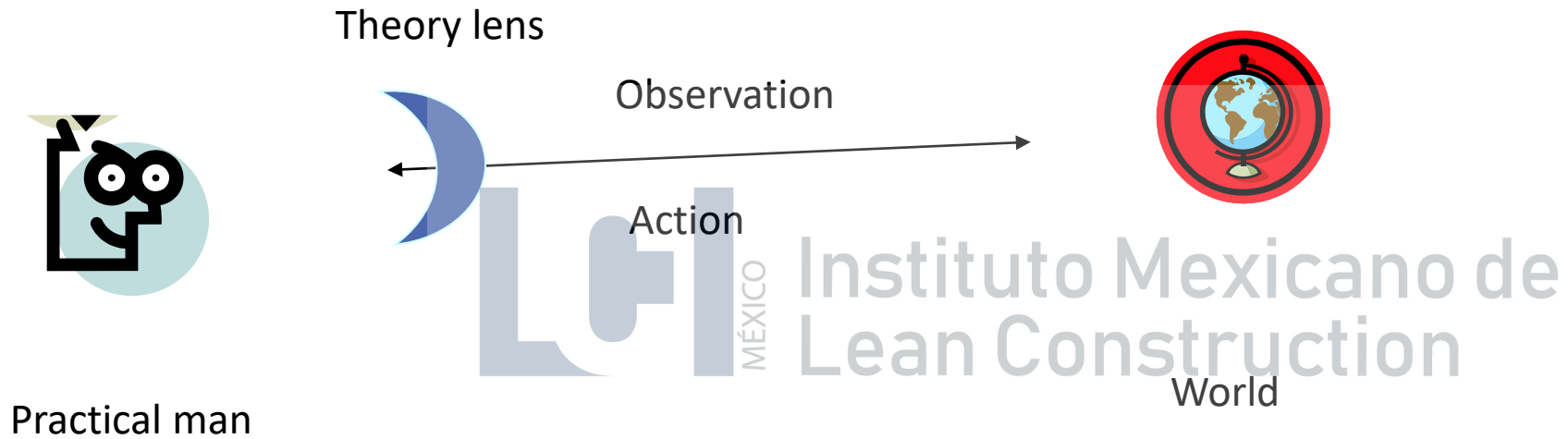
Practical man in the world



Practical man



Even the practical man has a theory lens,
but it is most often invisible



...or should we speak about blinkers?



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Where can the theoretical and philosophical ideas of Lean be found? Questions to be asked:

- How do we achieve our goals in production?
 - Theory of production
- What is out there in the world that we can use when producing?
 - Ontology of lean
- How do we get knowledge for producing?
 - Epistemology of lean

How do we achieve our goals in production?

Theory of production

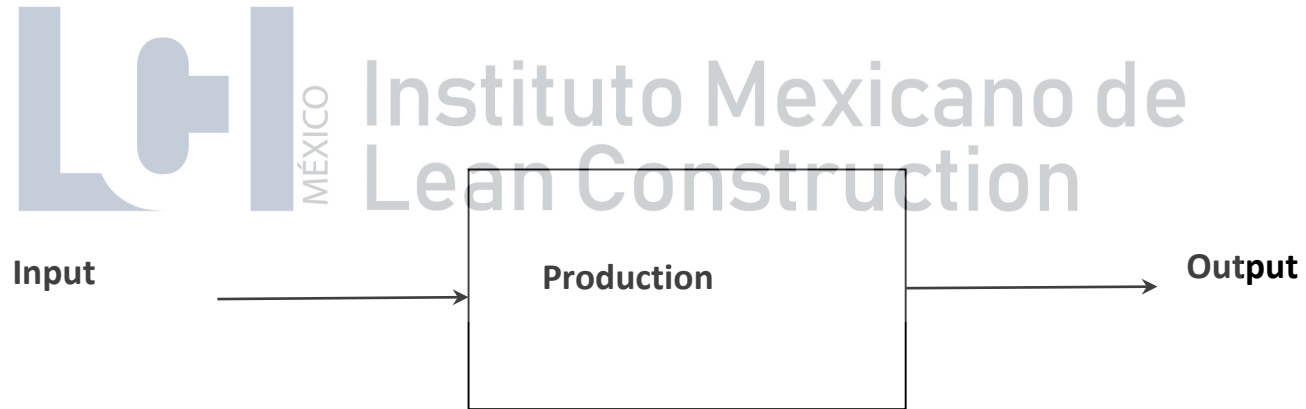
Which are the goals?

- Getting something produced in the first place
- For least costs
- With most value

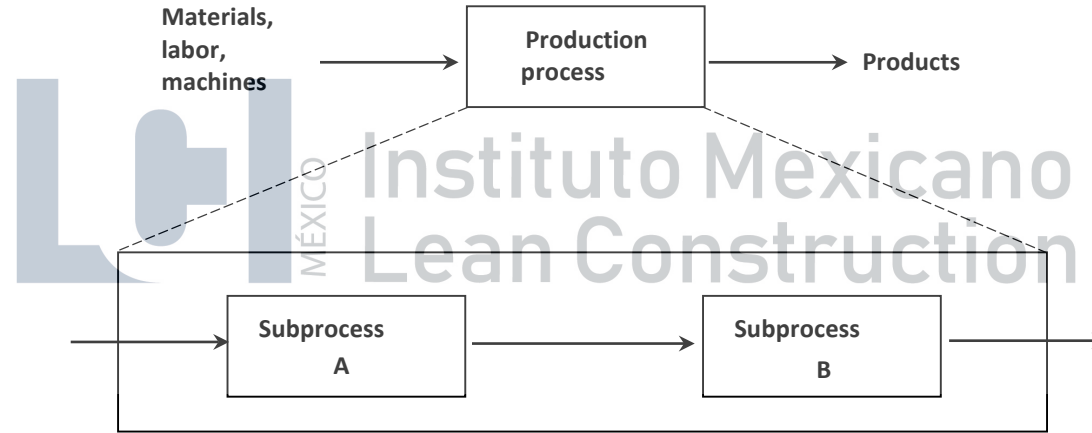


The conventional big idea of production

Transformation



Decomposition

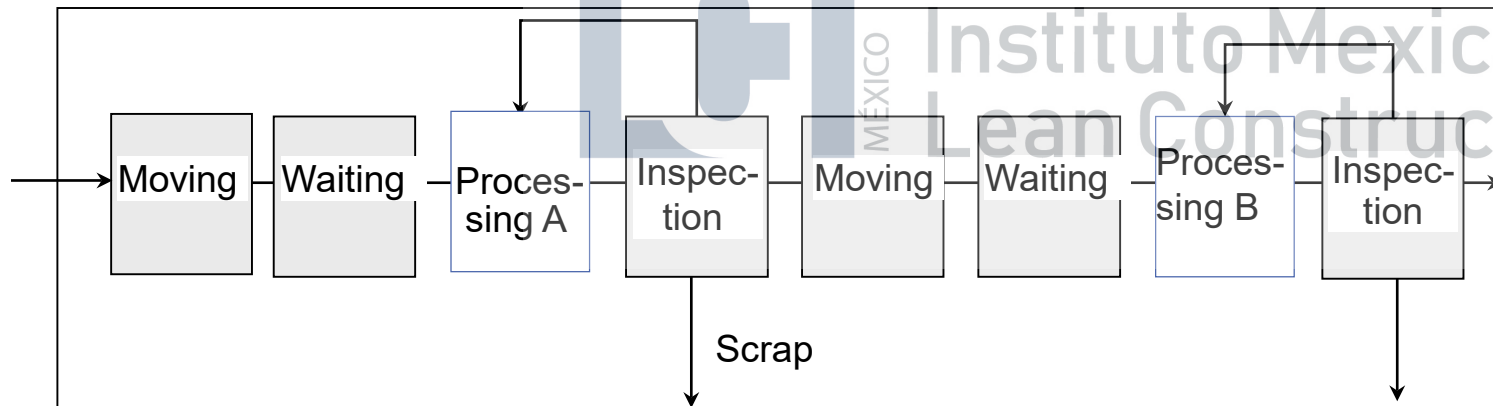


Powerful assumption: decomposed subprocesses are mutually *independent*!
Thus, the whole production effort can be integrated in an *additive* manner:
by minimizing the costs of each department, function, section, and work station
the total costs will be minimized.

Transformation theory

- Concept: Production is a transformation of inputs into outputs
- First principle: Decomposition of the total transformation into sub-transformations and optimal realization of each
- Further principles
 - shield the production process through buffering

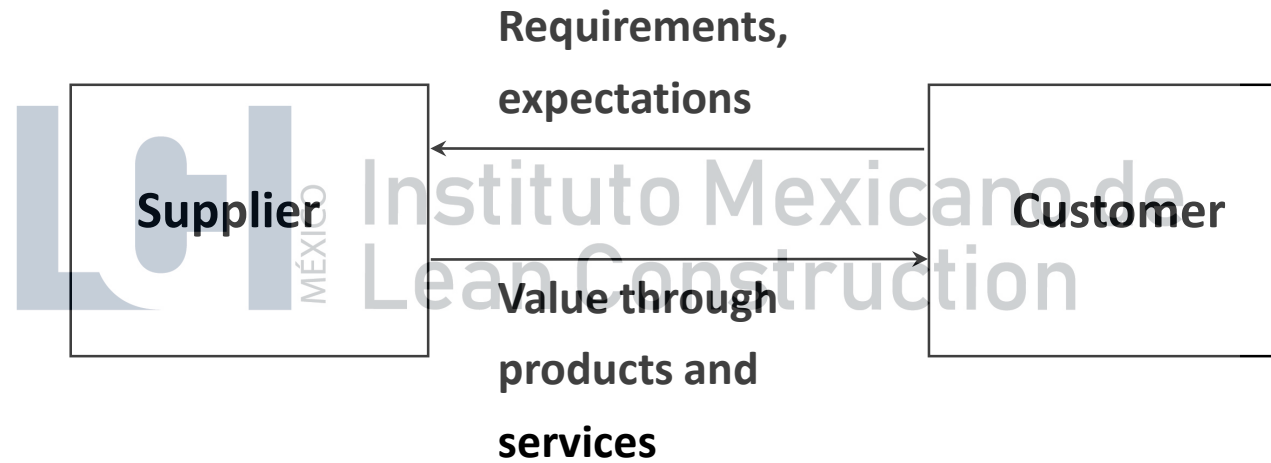
Production as flow



Flow theory

- Concept: Production is a flow, composed of processing (transformation) and other phenomena: inspection, moving, waiting
- First principle: Elimination of non-transformation phenomena (waste)
- Further principles: time compression, variability reduction, flexibility, transparency

Value generation



Value generation theory

- Concept: In production, value is generated for the customer
- First principle: Create best value for the customer
- Further principles:
 - Design to realize the customer requirements in the best possible manner
 - When producing, avoid deviations from what is intended

What is a valid/best theory of production?

- All are valid but partial
- **All are needed!**
- Compare to the task of describing a human being from a natural science viewpoint
 - Anatomy (thing view)
 - Physiology (temporal view)
 - Health (subjective view)

What is out there in the world that we can use when producing?

Ontology of lean

Two ontologies

Mainstream

- Thing metaphysics
- The world consists of things, substance
- We can distinguish separate, stable entities
- It is advantageous to divide our bigger entities into smaller independent elements and to understand or handle them separately

Lean

- Process metaphysics
- The world consists of temporal processes
- Processes are interrelated and constantly changing
- It is advantageous to focus on relations between entities or processes, for understanding or managing

The implications of Western thing ontology

- The relational nature of phenomena in production is denied at the outset; the need for collaboration is underestimated
- Continuous change is not perceived and consequently not managed

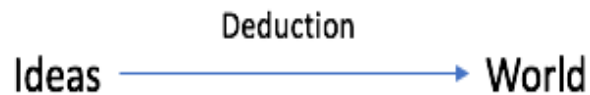


How do we get knowledge for producing?

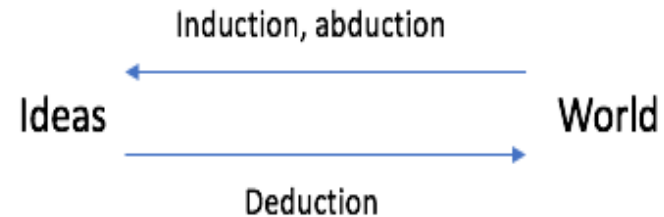
Epistemology of lean

Two ancient and continuously relevant epistemologies

- Platonic epistemology
- Deduction from the world of ideas towards the material world
- Aristotelian epistemology
- Induction from the material world to the world of ideas, deduction from the world of ideas towards the material world



a



b

Simply...

Mainstream thinking on engineering, production and management is Platonic

Lean thinking is Aristotelian



Plan-do!

Plan-do-check-act!

What does it mean that theories and philosophies are actionable?

Theory

- Theory of production
 1. Transformation theory
 2. Flow theory
 3. Value generation theory
- Ontology
 4. Thing ontology
 5. Process ontology
- Epistemology
 6. Platonic epistemology
 7. Aristotelian epistemology

Consequential action

1. Managing tasks
2. Managing flows of materials and information
3. Managing design towards customer requirements, and production away from deviations
4. Operating through independence and stability of things
5. Operating through relatedness and change in processes
6. Pushing extant knowledge to the world
7. Pulling knowledge from the world/pushing extant knowledge to the world

Lean is a theoretical innovation

Mainstream thinking

- Theory of production
 - Transformation theory
- Ontology
 - Thing ontology
- Epistemology
 - Platonic epistemology

Lean thinking

- Theory of production
 - (Transformation theory)
 - Flow theory
 - Value generation theory
- Ontology
 - Process ontology
- Epistemology
 - Aristotelian epistemology



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IMPORTANCE OF THE FOUNDATIONS: THE HISTORY OF QUALITY MANAGEMENT

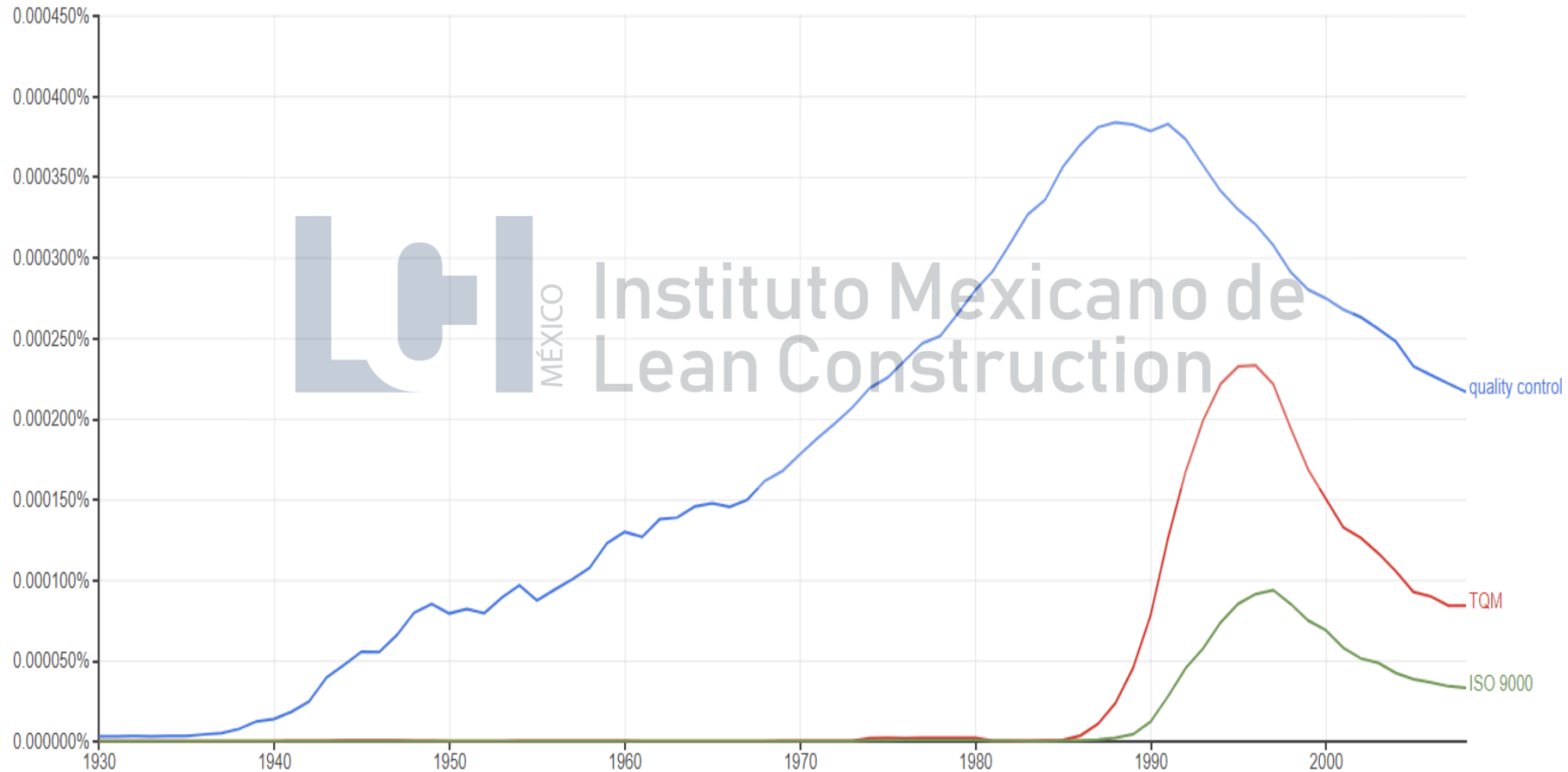
How can I show that my claims on the importance of the foundations are justified?

- By using the history of quality management as a case
- Quality management is generally seen as part of lean, and in the history of quality management, all the most important theoretical and philosophical ideas of lean are reflected
- However, in contrast to lean, quality management originated in the Western hemisphere, and it was based on theoretical ideas (top down) rather than being an accumulation of practical improvements (bottom up)

Decline of quality as an independent discipline?

- On TQM: “...during the first 10 years of the new millennium, the term TQM seems to have lost its attractiveness in Western parts of the world” (Dahlgard-Park 2011)
- On ISO 9000: “We have followed like sheep, pursued goals without challenging whether they were the right goals but most of all we have forgotten why we were doing this. It was to improve quality, but clearly it has not.” (Hoyle 2007)

The frequency of the word strings “quality control”, “TQM” and “ISO 9000” in books published in English in 1930 – 2008, according to Ngram.



What might be the cause?

- Scott and Cole (2000) claim that the quality effort is not readily linked to a well-identified, clearly specified set of ideas and practices but, rather, appears as a loosely coupled collection of orientations and practices.
- We politely disagree: The seminal authors on quality have presented influential theoretical and philosophical starting points for quality. Unfortunately, those starting points fall outside the usual paradigms of management scholars, and they have often failed to spot them.

The theoretical and philosophical starting points of quality, as defined by Shewhart and Deming

- Value generation theory of production
- Aristotelian epistemology
- Process ontology



Theory of production – value generation

Shewhart (1931): “Looked at broadly there are at a given time certain human wants to be fulfilled through the fabrication of raw materials into finished products of different kind. [...]The first step of the engineer in trying to satisfy these wants is therefore that of translating as nearly as possible these wants into the physical characteristics of the thing manufactured to satisfy these wants. In taking this step intuition and judgement play an important role as well as the broad knowledge of the human element involved in the wants of individuals.

The second step of the engineer is to set up ways and means of obtaining a product which will differ from the arbitrarily set standards for these quality characteristics by no more than may be left to chance.”

Epistemology

- The scientific method (Shewhart and Deming 1939) is to be used: “In this sense, specification, production, and inspection correspond respectively to making a hypothesis, carrying out an experiment, and testing the hypothesis. These three steps constitute a dynamic scientific process of acquiring knowledge”
- This is Aristotelian epistemology, rather than Platonic
- Later developed into Plan-Do-Check-Act cycle

Ontology

- “Out of the crisis” (Deming 1982): “Every activity, every job is part of the process. A flow diagram of any process will divide the work into stages. The stages as a whole form the process. The stages are not individual entities...”
- “Each stage works with the next stage and with the preceding stage toward optimum accommodation, all stages working together toward quality that the ultimate customer will boast about.”
- This is process ontology, rather than thing ontology
 - emphasis on relationships between different things and processes, and on continuous change/improvement

How did these starting points influence?

The case of Total Quality Management

- Dean and Bowen (1994) contended that in Total Quality Management, there are three basic principles: (1) customer focus, (2) continuous improvement, and (3) teamwork.
- These neatly correspond to the underlying theory of quality as discussed above:
 - Customer focus is compatible with the value generation model of production.
 - Continuous improvement is compatible both with Aristotelian epistemology and process metaphysics.
 - Teamwork is compatible with process metaphysics.

Unexpected tendencies

- Two unexpected tendencies become visible, going forward:
 1. independently from the quality movement, quality practices and techniques were developed based on another theory of production, (improvement outside the starting points) and
 2. the original starting points started to be forgotten or misunderstood (deterioration).



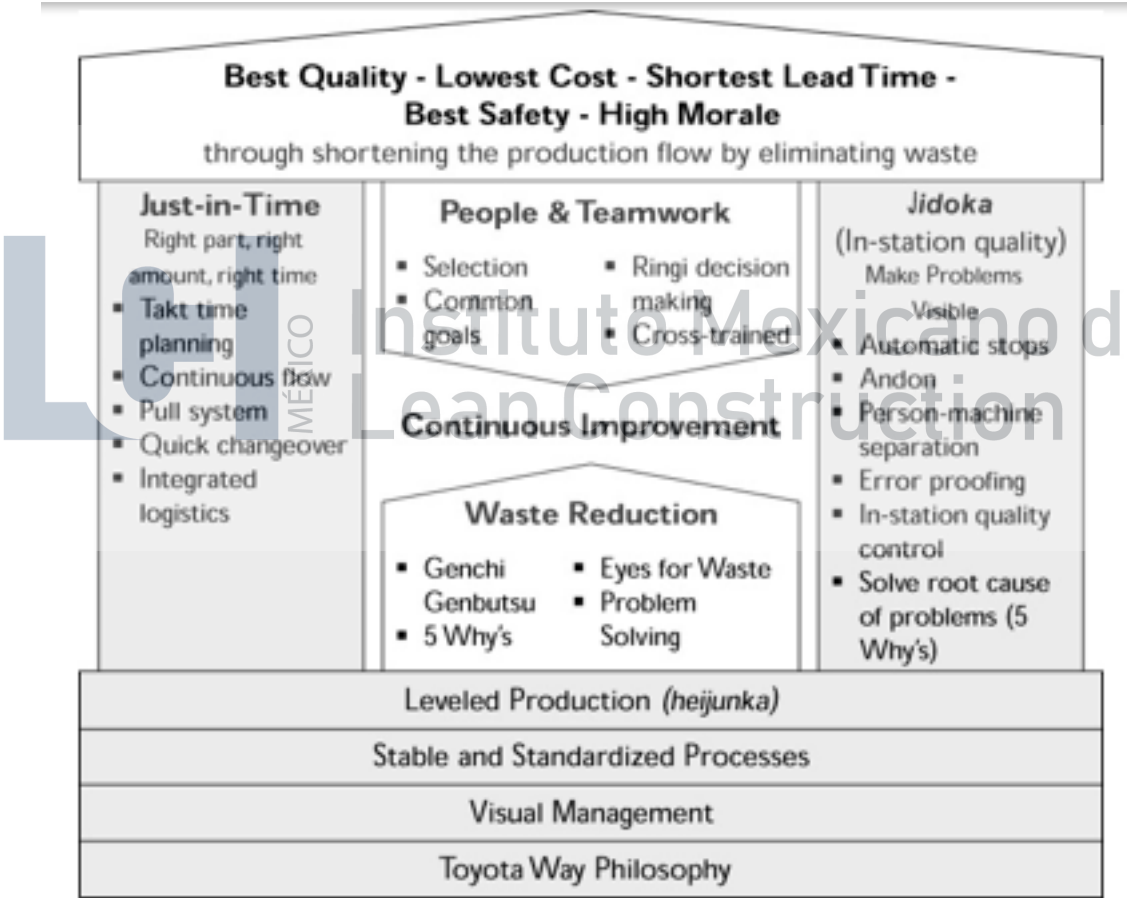
Quality at Toyota

- “Just-in-Time dictates that parts are delivered to the right part of the assembly line, at the right time and in the right amount. However, for this to work effectively, Ohno realized that another factor had to be controlled: quality. Parts must be flawless and defects must be eliminated before progressing along the line. This is when *jidoka*, the second pillar of what would later become the Toyota Production System, entered the picture.” (Toyota 2004)

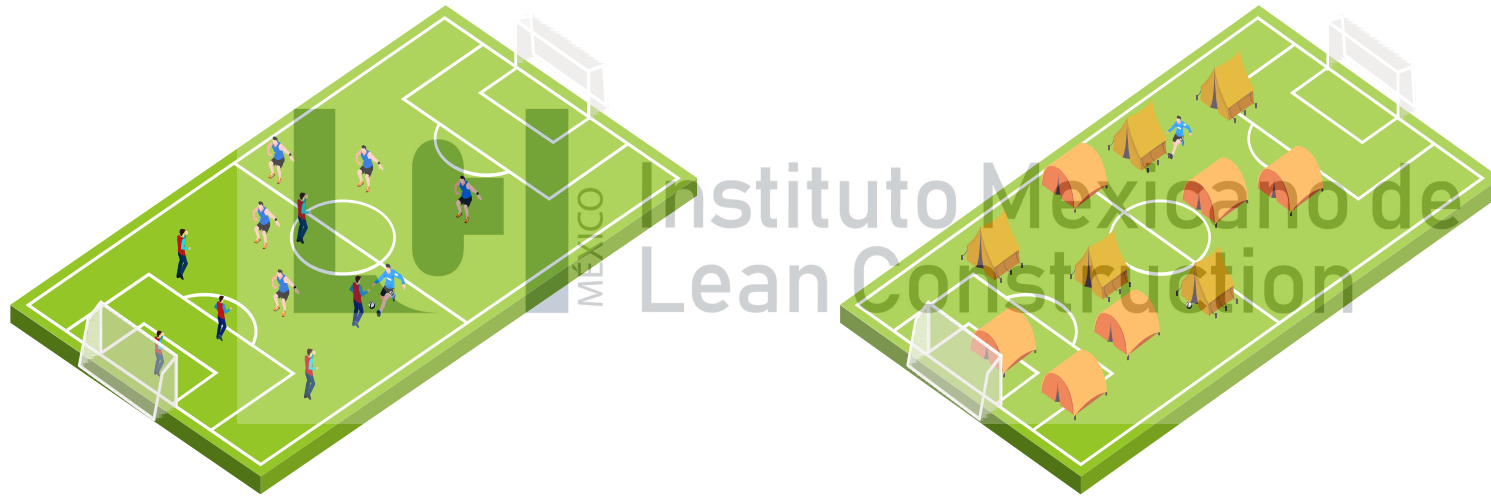
What did this mean?

- Quality was needed, not primarily for the sake of the customer, but for realizing the Just-in-Time system
 - Quality was needed for reducing temporal variability, rather than dimensional and functional variation only
- Quality was approached from inside production, and generic tools, such as source inspection and fool-proofing mechanisms, *poka yoke*, were promoted for ensuring zero defects in produced parts (Shingo 1988).
 - This contrasts to the mainstream quality thinking that looks at quality as an outcome of production, and assumes the rectification of a quality problem to be one of a kind, separate from general improvement of production.
- “ISO 9000/QS 9000 was unnecessary for Toyota, moreover, because it was incomplete: It did not deal with cost, one of the two pillars of management.” (Hino 2005)

The Toyota House by Liker



Why is it possible to make goals?



What happened to the epistemological starting point?

- ISO 9000 series of quality standards, first published in 1987 and revised in 1994, 2000 and 2015
- These standards contained a prescriptive approach to quality: they stipulated which kind of documents should be prepared for the quality system.
- This represents Platonic epistemology (Koskela et al. 2018): existing knowledge is pushed to the world.
- Outcome: not even one case where identified quality problems would have led to improvement action in the studied organizations that followed the mentioned standard could be found in a recent Irish research (Taggart 2016).
- It is only the newest version of the standard (2015) that takes a much less procedural approach and stresses the application of the PDCA cycle at all levels of an organization.

What happened to the ontological starting points?

- In Harrington's (1991) influential book on business process design, only 2 % of the pages (5 and a half pages out of 274) are addressing continuous improvement
- Armistead and Rowland (1996) state: "...business processes can be broken down into a hierarchy of smaller processes which share the same characteristics".
- The seven ISO quality principles:
 - Customer focus,
 - Leadership,
 - Engagement of people,
 - Process approach,
 - Improvement,
 - Evidence-based decision-making,
 - Relationship management
- Internal collaboration and teamwork are missing from the ISO principles!

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What can be concluded?

- Mistakes committed in the development of quality management because of lacking theoretical and philosophical understanding
 1. Production (including design) is a whole; all theoretical angles need to be used
 2. Production is best approached through process ontology
 3. For knowledge production and use, Aristotelian epistemology is more useful than Platonic epistemology



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CONCLUSIONS

The big picture

- Environmental concerns are real and growing, and wasting of energy, food, water and time is found to be a considerable cause
- Costs for slowing down environmental degradation, not to speak of reversing it, are huge:
 - Extraction of CO² from the atmosphere
 - Cleaning of oceans
- This, in addition to the R&D for creating recycling economies...
- and development for securing decent living conditions for the global population, means
- that we need to be much more productive, much more efficient in all we do.
- **Improving management is thus enormously important – management should be a force for the good!**

Practical frontiers (beyond implementing existing knowledge)

- Developing practices as countermeasures to problems
 - As done from the beginning of lean construction
- Developing (lean construction) practices inspired by lean in other contexts
 - Adoption and adaptation
- Developing practices through theoretical foundations
 - Taking theoretical understanding seriously and shaping the organization around it, say to be transparent, learning etc. across the whole
 - Example of related work: Ergo Pikas' doctoral research on design management
 - Developing digital practices in a lean context

Educational frontiers

- Lean is surfacing knowledge and skill needs that have not been adequately tackled in the past
 - Problem solving methods and skills
 - Collaboration methods and skills
 - Continuous improvement
 - Visual management/communication, how to make things transparent
 - Basics of production/operations theory
 - Underlying assumptions about the world
 - Underlying assumptions on how to acquire knowledge

Theoretical frontiers

- Academic research should not idle; Plato's and Aristotle's Academy represented a sudden burst of increase of knowledge – why not possible today?
- Clarification and validation of the foundations of Lean needed for several reasons
 - Related disciplines give mixed, shallow and even erroneous messages
 - To create ingredients for teaching
 - To persuade
 - To unify human knowledge
- Expansion of such knowledge that is currently under-developed, Lean is not complete and stable
 - Theory of design

What is lean? What is not lean?

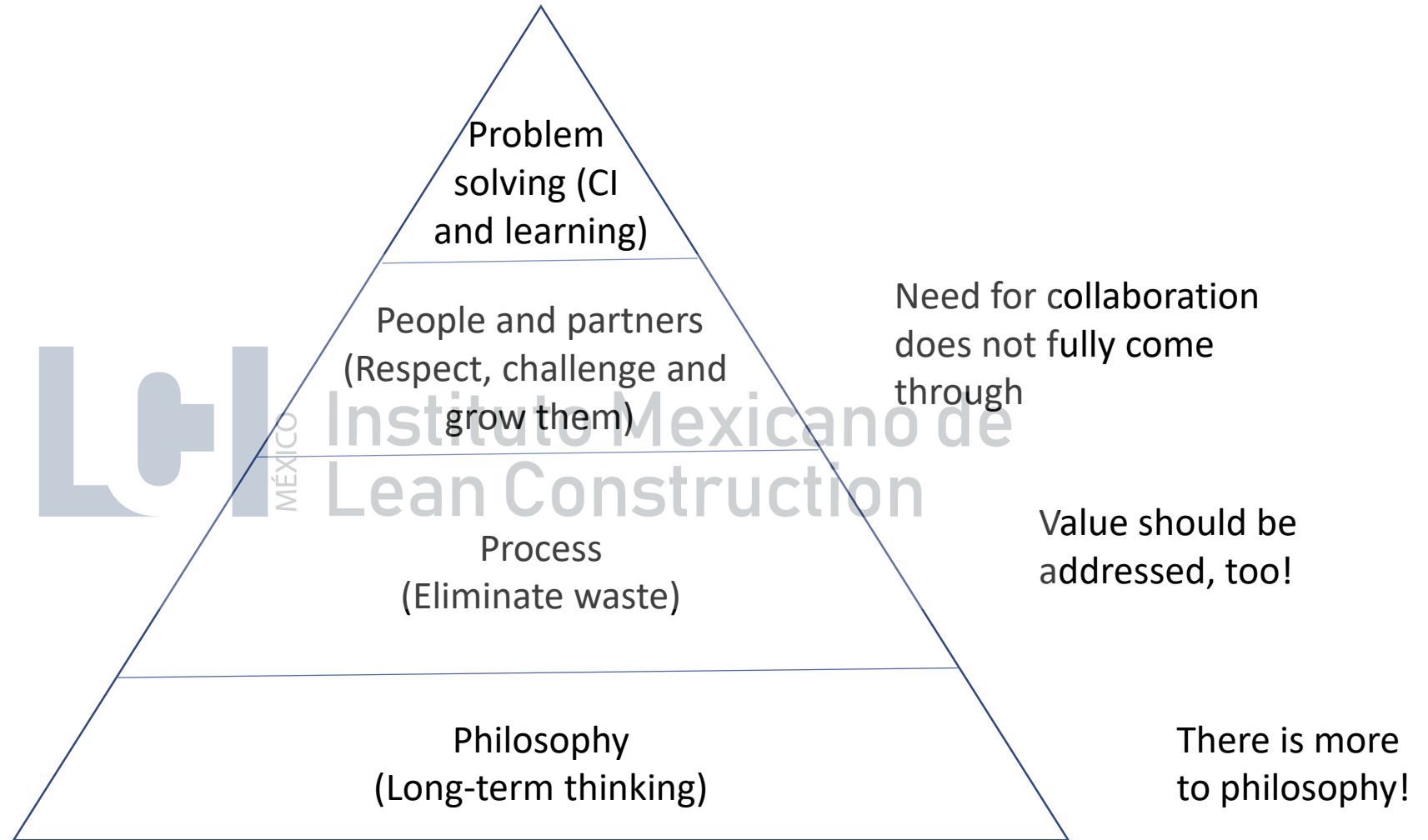
Mainstream thinking on management and engineering

- The central and noble task of managers and engineers is to find the best possible (**optimal**) plan or design
- It is the duty of others to realize the plan or design
- Leads to the need for organizational control

Lean thinking

- Besides enabling the finding of the best possible plan or design, managers and engineers should focus on reducing the gap between the intended/ideal and the achieved (this gap equals **waste**)
- There will always be waste (unnecessary use of resources)
- Leads to the need for collaborative learning and continuous improvement

Critical view on Liker's interpretation/ TPS



Bibliography

- Koskela, L. (2000). *An exploration towards a production theory and its application to construction*. VTT Technical Research Centre of Finland.
- Koskela, L. & Kagioglou, M. (2005). On the metaphysics of production. In *Proceedings of 13th International Group for Lean Construction Conference*. (pp. 37-45).
- Koskela, L., Ferrantelli, A., Niiranen, J., Pikas, E., & Dave, B. (2018). Epistemological explanation of lean construction. *Journal of Construction Engineering and Management*, 145(2).
- Koskela, L. (2017). Why is management research irrelevant? *Construction management and economics*, 35(1-2), 4-23.
- Koskela, L., Tezel, A., and Patel, V. (2019). “ Theory of Quality Management: its Origins and History”. In: Proc. 27th Annual Conference of the International Group for Lean Construction (IGLC), Pasquire C. and Hamzeh F.R. (ed.) , Dublin, Ireland, pp. 1381-1390 DOI: <https://doi.org/10.24928/2019/0259>



Thank you!
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