

SENSEMAKING OF GUIDING PRINCIPLES IN CONSTRUCTION PROJECTS

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ABSTRACT

Processes and operations can be supported, improved, or scrutinized as an active response to guiding principles that challenge the status quo. When it comes to the subject of complexity vs simplicity the principles can contradict each other, and even flow tends to work towards simplicity while value generation adds complexity. By addressing the importance of awareness of their counter effects they can be used with care and gain even larger value as a result. Done in ignorance their use might create chaos, project loss, or production failure. The sensemaking tool, Cynefin, is used together with some core principles of lean to illustrate and explain the intent of the paper. A fundamental difference in viewpoint of a project's nature is addressed since the right sensemaking of appropriate domain in Cynefin is important for the right use of lean principles. A discussion on a fundamentally different understanding of the phenomenon of projects adds to the ontological training urged by other IGLC members. This paper argues that projects are fundamentally unpredictable and hence should be more often sensed in the complex domain, rather than in the complicated or simple domain.

KEYWORDS

Simplicity, complexity, transformation-flow-value, continuous improvement, Cynefin.

INTRODUCTION

Lean construction can relate to multiple lean principles that give meaning in accordance with the lean “way of thinking” (Hines et al., 2004). Some lean construction principles can be recognized in the keyword list for the 2022 IGLC conference. “Continuous improvement/kaizen”, “standardization”, “production pull” “pull planning”, “takt planning”, “collaboration”, “trust”, “flow”, “waste”, “relational”, “reliable promising”, “value stream”, “visual management”, and “concurrent” are all examples of spelled or close to being spelled principles (Skaar et al., 2020) that partially work as explanations for the “concept” (Koskela & Kagioglou., 2005) of lean construction. Lean is an ambiguous concept and since it has mainly been coined after inductive reasoning from observations it cannot be concluded as a certainty, especially since it is reshaped within different industries and contexts. In this paper, we will see processview (Koskela & Kagioglou., 2005) as a metaphysical ingredient in lean thinking, also supported and represented by a selection of lean principles. We use the Cynefin framework (Snowden, 2007) to discuss the phenomenon of a construction project regarding both design and production. The nature of a project and whether we should sense it as complex or

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complicated are most debated for production. The reasoning behind this is that the use and intention behind lean principles or lean thinking will vary depending on where a project is by nature. As an example, if we use “takt” as a principle and sense a project as complicated, hence in an ordered system, we can use sufficient planning resources and plan it in detail and predict the progress of the project. If the project is complex on the other hand we should build in enabling constraints and enable the resources for emergent practice to deal with deviations and unforeseen events to maintain or gain “takt”.

THEORY

THE CYNEFIN FRAMEWORK

The Cynefin framework (Snowden, 2002, Kurtz and Snowden 2003, Snowden and Boone 2007, Snowden 2010) is a sensemaking framework with five domains, see figure 1. The Cynefin framework is divided into an ordered system, with domains of simple and complicated and unordered system with the domains complex and chaotic, in addition, disorder is the fifth domain for the state when you have not made sense of where you are.

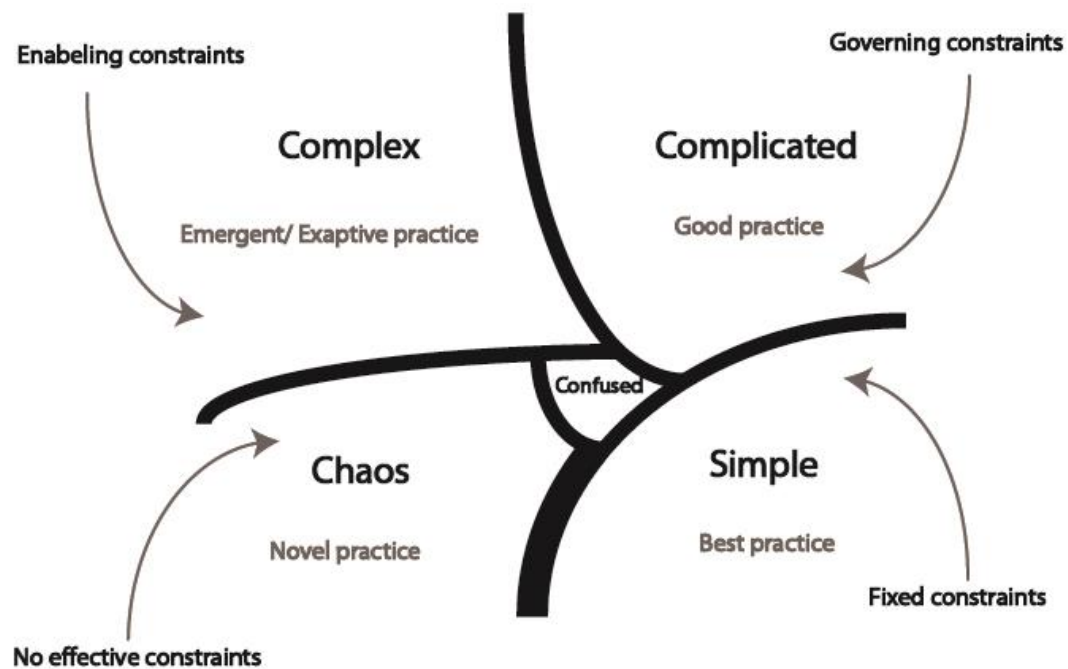


Figure 1; Cynefin framework with 5 domains and suggested constraints and practice. Based and converted from Turner, Snowden & Thurlow (2022) with copyrights to Cognitive Edge

Snowden makes a point of the Cynefin framework not being a categorization framework, but a sense-making framework. The point is to try to figure out or make sense of the world to act in accordance with the domain you are in. The need for sense-making is continuous since the context or problem you are dealing with may change because of changing situations and circumstances and hence move into a different domain.

The Cynefin framework has been mentioned in earlier papers within the IGLC network (Koskela et al., 2005, Xu & Tsao, 2012, Biton & Howell, 2013).

LEAN THINKING AND GUIDING PRINCIPLES

Lean thinking can be seen as a way of reasoning with lean principles, but what are those principles and how should they be applied? The principles representing lean thinking are not limited (Koskela, 2004) to the five principles by Womack & Jones (1990) that first coined the term “Lean thinking”. As an example, the original five principles do not make any reference to people (Bicheno & Holweg, 2016), which is part of Toyota's official principles in their lean house (Liker, 2003). If we define lean thinking as a process viewed (Koskela & Kagioglou, 2005) mindset and a challenger of the domination of thing- or substance view the principles should be a guide for this change. The TFV theory of production (Koskela, 2000) acknowledges transformations, value generation, and flow as valuable for production, but lean principles often represent a counterweight to the domination of thing view and hence become a guide towards more use of flow and value generation. Lean thinking will in this paper be defined as using all principles that can enable a more process viewed look at the world, a process viewpoint will be preferred or at least challenge a more thing viewed interpretation. Table 1, shows some sources of inspiration for principles that can guide towards a process viewpoint.

Table 1: Some references to principles that can support a process viewpoint.

Reference	Principles
Liker, 2003	14 Management Principles and Toyota's official lean house principles
Deming, 2018	Demings 14 points (principles) for management
Ballard Tommelein, 2021	Principles for LPS
Fowler& Highsmith, 2001	12 principles of Agile software
Womack and Jones (1990)	5 principles of “lean thinking”

Principles enabling a process viewpoint can be applied to the way we think but indirectly also act on the world, so by using the principles in our narrative and active management as constraints they can guide change towards reduction of waste and increased value creation.

METHOD

This paper is based on a literature review on Complexity and Cynefin in the IGLC conference papers and also the status of development of the Cynefin framework in published literature. It is mainly based on a conceptualization (Jaakkola, 2020) of the meeting point between Cynefin and process view principles and the phenomenon of design and production in construction. The theoretical approach to the phenomenon of construction is mainly inspired by the work of Sven Bertelsen and Lauri Koskela with different co-authors in the IGLC community. The discussion is about placing this phenomenon into the Cynefin framework and linking it to the use of guiding principles. The work is a part of a Ph.D. thesis that uses guiding principles as an important part of

an organizational framework for process viewed and changing environments, now testing the theory as a pilot among different Norwegian executive teams.

DISCUSSION

THE DOMAIN OF DISORDER

The domain of disorder in the Cynefin framework is the domain or state of not knowing what type of system you are in (Snowden, 2007). Based on the literature we can spot that there are fundamental differences in sensing what kind of system construction projects are. The different opinions can be recognized in the difference between Flyberg and Hirshman (Kreiner, 2020), these differences are also earlier acknowledged in IGLC about cost management (Koskela & Ballard, 2021). In short, Flyberg sees an emerging problem or issue in construction as a lack of planning, while Hirshman claimed that projects have an inherent and genuine uncertainty that the actions and outcomes cannot be known in advance, only forecasted (Kreiner, 2020). Design as a phenomenon is easier to acknowledge as a mainly complex endeavour since it among others contains reciprocal interdependencies (Kalsaas, 2020; Thompson, 2003), has more than one solution (Reinertsen, 1997), and is maturing as it develops from the start to finish (Nesensohn et al., 2014) and might be considered to be a “wicked problem” (Rittel & Webber, 1974; Buchanan, 1992). A more debatable question is whether production in construction “after design” is complex or complicated (Annweiler, 2019; Kreiner, 2020), we will add to that discussion later in this paper. Principles like “Focus control on the complete process” (Alarcón, 1997) and “doing the right things and gaining the Big Picture” (Bicheno & Holweg, 2016) is about understanding and reasoning about the situation and can be used to initiate action (Skaar et al., 2020) in favor of gaining an overview from the domain of disorder.

THE SIMPLE DOMAIN

In the simple or obvious domain, cause-effect relationships exist and are evident and predictable, hence rigid constraints can be applied (Snowden & Boone, 2007). If construction projects are in the simple domain you only need to sense then categorize and then respond. The phenomenon of design does not fit in the simple domain just argued by the fact that design has multiple solutions. And for production, there are variables that no project can truly ignore, human interactions, weather, geographical conditions, surroundings, etc. People’s tendency to be biased towards simplification (Bazerman, 2001; Bertelsen, 2003) also gives warnings against placing projects in the simple domain.

We argue that a construction project should therefore never be treated as a simple endeavour. What does the claim mean in practice?

1. You cannot make a recipe/ plan for one project and use it again for the next project, it needs at least experts to sense and analyse the context, and then make a new plan (respond). The claim is made also for projects where design is done and only production is left.
2. Best practices do not exist for coordinating design or production, not even the smallest task should be treated as simple if you want to avoid emergent deviations. There is always room for improvement from a process viewpoint, so best practice should in lean thinking not be used.

3. The principle “Simplify” can be used to simplify by minimizing the number of steps, parts, and linkages (Alarcon, 2014), to make it less complex or complicated and/or reduce waste, but no activity should be fundamentally treated as simple.
4. If participants sense that a project is in the simple domain, they should move to disorder and sense again to avoid a collapse into the chaos domain. Especially if rigid constraints are used. Treating something as simple will de facto not give room for improvement, but to be efficient everything cannot be improved all the time. So for pure transformation activities that seem stable, they can be looked into fixed constraints and just transformed, but the main point is that they should not be sensed as simple only treated as simple. A cost/benefit evaluation on necessary available resources to cope with deviations should be made.

If a project is sensed to be in the simple domain principles like “lower the water to expose and remove the rocks” (Schonberger, 2014) or ”Find problems where you think none exist” (Davey, 2017) can move you over to a more complicated domain and hence create more value since experts are available in a typical construction project. Both mentioned principles are metaphors for the attitude of making things tougher or more ambitious to see the obstacles that hinder the improvement. “Lowering the water” can be translated into more actionable ambitions like “Reduce construction time on projects to half the normal time” and “The rocks exposed” is a metaphor for the constraints that must be dealt with or removed to fulfil the ambitions.

THE COMPLICATED DOMAIN

To be in the complicated domain you should be able to sense, analyse and respond. Cause-effect relationships exist in the complicated domain, and there is a right answer though not self-evident. Experts should be able to put the system in the correct order and postpone the events. Governing constraints together with good practice can be applied to control the system. Whether construction projects normally are here or in the complex domain can be debated as earlier mentioned. Even within IGLC publications differences in this viewpoint can be spotted, where one view claims the world to be mathematically identifiable, hence predictable and deduced (Kenley, 2005) and the other view is that claiming a project is more complex and unpredictable (Bertelsen & Koskela, 2002, Bertelsen, 2003). Kenley (2005) agrees that projects are complex, but at the same time argues that on-site processes only appear complex. Aligned with the Cynefin framework things that are predictable are by definition not in the complex category, so even if Kenley recognizes the complexity of human interaction is it right to interpret his claim that they do not influence the effectuation of on-site activities?

Critical Path Method (CPM) combined with the more visual Location-Based Management Systems (LBMS) can be preferred if projects should be fundamentally perceived as complicated, as stated by Kenley (2005). If construction projects by nature are ordered and predictable sufficient planning resources should be applied to the projects since the consequences of not making a detailed enough plan are costly. The underlying assumption if a project should be perceived as a complicated project is that experts can postpone everything. From the experience of the use of Percent Plan Complete (PPC) in construction projects, this often seems not to be the case. Ballard reported a PPC of around 50% in his thesis (Ballard, 2000) on the projects that did not use the Last Planner System. We claim that emerging matters are a reflection of the complexity of the phenomenon of construction projects not just a lack of planning.

If we sense a construction project to be fundamentally complex (Bertelsen, 2003), and more emerging the use of CPM will have fewer arguments. Then the production control principle (Ballard et al., 2009), “Plan in greater detail as closer you get to the work” will be resource efficient, a principle the Last Planner System uses in the plan hierarchy from milestone plan to a detailed production plan. But even though construction projects are fundamentally complex trying to move them into the domain of complicated can reduce waste. Many of the activities of a project in production can “go as planned”. Flow, takt, production pull, continuous improvement, etc. are easier to cope with and can be applied even though the project is sensed to be complex. The Cynefin framework makes a differentiation between governing constraints for the complicated domain and enabling constraints for the complex domain.

Governing constraints are boundaries and can as an example be defined rules, standards, or procedures. If takt is applied as a governing constraint, takt becomes a “rule”. This might work even if projects are sensed as fundamentally complex, but must be used with caution to avoid conflicts and emerging events. If takt is applied as an enabling constraint it will be implemented as a principle and a challenger of the status quo. Takt, flow, and standardisation are principles that work toward simplification. Principles that make it more complex to manage, like involvement, can be combined with simplifying principles to cope with emergent matters. The use of backlogs with prepared activities is a practical example of measures that can be used actively to cope with the inevitable emergence in today's business. From a process viewpoint, even a planned plan can be challenged and improved further. A plan that is not challenged to be improved mainly goes as planned or goes worse, the opportunities are ignored with a thing view.

THE COMPLEX DOMAIN

In the complex domain, the environment is in constant flux and unpredictable. Cause-effect relationships are not clear but could be observable in retrospect.

Introducing a process view into construction (Bertelsen, 2003), makes a clearer argument that reality is fundamentally complex especially applicable to the social world. An underlying complex world underpins the need for awareness of complications if simplification is done. This does not mean that a plan should not be made, it means that a plan should never be mistaken to be the truth, put in other metaphorical words the plan must be adjusted to the “terrain”, not the “terrain” to be adjusted to the plan. There is a fine distinction here, but a typical attitude after an unforeseen event is that the cause was a lack of sufficient planning. If a project is fundamentally complex all events that may emerge in a project cannot be planned for. So instead of trying to make a comprehensive list of all events, a shift towards more flexible methods to cope with emergent events is a better attitude and can be more efficient.

Many human biases that ignore the complexity of the world have been noted (Bazerman, 2001; Kahneman, 2011; Kahneman et al., 2021), two of the most relevant for this discussion might be:

1. Attribute substitution: Humans tend to substitute an answer to a complex question with an answer to a more simple question.
2. Hindsight bias: After an event has occurred humans tend to see the event as predictable, despite having little or no objective basis for predicting it.

So why can projects be in the complex domain? The part of production that consists of transformation can be argued to be in the complicated and even simple domain for

small clear projects. From a thing viewpoint seeing transformation, it should be sensed only as complicated since it before assembly consists of defined building blocks, with sequential dependencies and solutions that experts should be able to identify. In production, the value creation can be limited and hence be less complicated to cope with.

Since the nature of construction is about unique products in temporary organizations (Ballard & Howell, 1998; Bølviken, 2012). The uniqueness of the product can be argued to be less complex since many of the processes and activities are the same from one project to the next, but variables like weather, geography, geology, and existing infrastructure increase the possibility of emergence and are unpredictable events (Bertelsen, 2002).

A key reason for added complexity in a construction project lies in the complexity gained because of people's interaction. Leading people is a complex matter. Construction projects consist of different organizations and people often without any track record or possibility to analyse and predict the new constellations' behavioural patterns.

Because of the underlying complexity emerging and unplanned events are inevitable and should not come as a surprise. The leader's narrative should adapt to this and actors doing their best should not be blamed as a consequence. Projects not hitting their targets are as a consequence, not a "thing" that you necessarily can identify on the project level and eliminate upfront. "Bad construction projects" is not a thing it's a set of processes done in a complex world, that can be improved.

The complex domain calls for enabling constraints. Guiding principles (Skaar, 2019; Skaar et al., 2020) on both strategic, tactical, and operational levels (Clausewitz, 2003; Covey, 1992) or organizational, managerial, interpersonal, and personal levels (Clausewitz, 2003; Covey, 1992) are enabling at all those levels and can be used as constraints in an organizational framework. "Plan in greater detail as the closer you get to the work" (Ballard et al., 2009) is such an adaptation of guiding principles or principles recognizing a complex world.

THE CHAOS DOMAIN

In the chaos domain, no cause and effect relationships are perceivable, the preferred behaviour is to act, then sense, and then respond. Meaning no reasoning towards the context is recommended, so if the fire alarm wakes you up in the middle of the night you might sense chaos and could then follow the predetermined procedure that enables acting, but if that procedure is sensed not to be appropriate, new responses are required. If a situation like this becomes unstable you are entering the domain of chaos, and stability is the goal if you want to get out of the domain.

A lead product designer in Norway has been interviewed by the author of this paper. He claims he liked to stay in the chaos domain as much as possible because he was much more creative there. He liked though requirements and objectives, they often triggered the need to be even more creative. He used time in the beginning with the customer but did not involve the customer at all in the creative process. His statement contradicts the lean notion that you should involve and get feedback from the customer to test your product. A reflection made based on this was that letting in the customer in an already complex to chaotic process could make the process too chaotic to handle. The designer believed that the value the customer got was greater if the team could work undisturbed, he is thereby making a controlled environment where he allows chaos or highly creative processes to enter.

A high level of creativity is often welcomed at the beginning of the design of a construction project and in the early evaluation of production methods, but in a relatively short period into the project, it becomes a treat to uncontrolled chaos and creativity is limited. The actual production phase of a construction project focuses more on the reduction of internal waste through flow and transformation than perceived value creation (Hines et al., 2004). Ongoing production should avoid the chaos domain.

CONCLUSIVE DISCUSSIONS AND FINDINGS

THE CONFLICTING USE OF PRINCIPLES

Under the chapter “Lean thinking and guiding principles” we defined lean construction principles to be principles that can enable a process viewpoint. This is also a crucial point when actively using the principles, a principle like standardization can in a thing view perspective be interpreted as trying to make processes static, rule-based, and restrictive while in a process viewpoint a standard can be interpreted as a systematic and temporarily steppingstone for process improvement with a dynamic nature (Spear & Bowen, 1999).

Is there a logic in using the principles to work towards simplification of some areas and towards complexity in other areas in the same project? Or does this reflect a different viewpoint of the users of the principles? Since many tools, methods, systems, and practitioners can combine principles with this contradiction, are they doing it wrong? It might not be intuitively logical to combine principles like standardizing and “creating flow” together with principles like involving, continuously improving, and welcoming change. The first set of principles limits variation, stabilize, and simplifies the process, and the latter set of principles tend to make it less defined, and create more tension and complexity? The use of conflicting qualities has previously been used intentionally, Lexus “Yet” philosophy is an example of this. Where seemingly contradicting or conflicting qualities are put together, like “Fast, yet fuel-efficient” and creates a more constrained environment, in a way it can be compared with increasing the distance between the intended and achieved purpose (Koskela et al, 2019).

If we acknowledge the world as a complex world an attempt to stabilize a process can at least gain three different positive effects;

1. Stabilization simplifies the process so that emergent situations and variability within the process can be recognized more clearly.
2. Stabilization of one process can shift resources to other processes with more potential for value creation.
3. Stabilization can in itself create end value through reduction of cost (reduced resources, storage, etc), higher efficiency (accurate and fast delivery time), and quality (fewer errors, higher safety, etc).

On the downside, stabilizations limit the dynamic and flexibility that can gain value creation of more novel and enhancing character. So stabilization and simplification should be challenged to deliver more customer perceived value creation. Having high ambitions, “pushing the envelope” (Miles, 1997), and “never accepting the status quo” (Davey, 2017) are principles that seek higher value creation.

Principles that are used for more value generation might as a consequence move the process towards more complexity, while principles that are used to move the processes towards simplification, are mainly done for waste reduction or preparation for transformation, see figure 2.

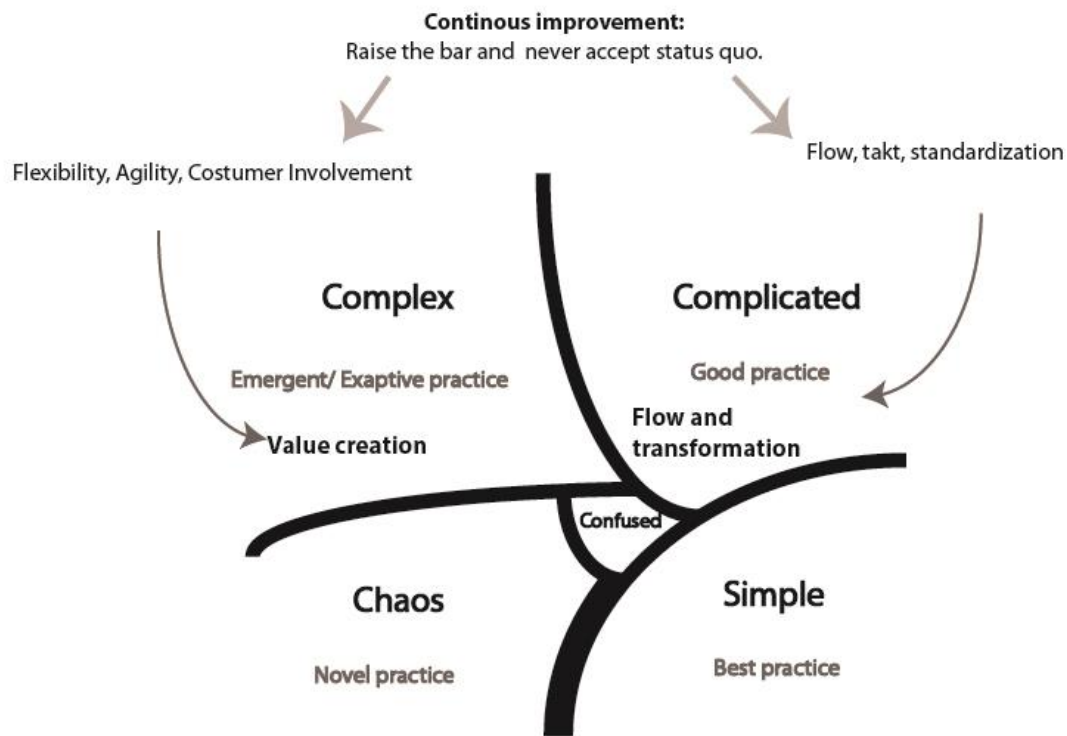


Figure 2; Modified Cynefin framework with guiding principles for flow and value creation, based and converted from Turner, Snowden & Thurlow (2022) with copyrights to Cognitive Edge

The opportunities that lie in value generation from the complex domain, are an argument for staying in the complex domain, even if the stabilization of a project makes it feasible to draw it towards the complicated domain. An example of value creation in production can be constantly trying to increase production as a team beyond the current schedule.

FUTURE RESEARCH

Further research can be done on what domain project management sense their projects and see if differences in this viewpoint affect project conflicts, manager’s narrative, the team spirit, and motivation for team members.

Research can also be conducted on how a combination of guiding principles can be used together with more governing constraints in a project where all project members sense the project to be in the complex domain. How can knowledge on the subject of differences in project sensing influence a project team’s attitude towards emerging opportunities and negative risks?

Further research and conceptualization on the differences in a deterministic view on task durations vs a stochastic view and how this can be related to thing- vs processview and sensing of domains in the Cynefin framework will also be possible progress.

CONCLUSIONS

This paper claims that we live in a complex world and that this should also be the ontological attitude we take towards construction projects. An understanding of the different domain’s capabilities might enable projects to seek the discomfort of value

generation in more complex contexts and even within contained chaos, but at the same time seek possibilities for waste reduction by constraining parts of the project towards simplification to stabilize the project. Since principles in their nature are enabling they should be used like principles down to the operational level. Principles like flow, takt, and standardization can be used to enable action to reduce waste and prepare for transformation. To manage these principles they are often presented by the management as governing constraints, if done so the project leaders should be very aware that it is done as an effort to constrain an underlying complexity. Awareness of complexity might change the narrative of how governing constraints are presented to the project team and might enable the use of principles like involvement even though the sensed complexity initially increases. We call for higher use of flexible and relational principles that support complexity in combination with the use of principles that enable simplicity. Project teams with a high understanding of the underlying complexity might also be better to take advantage of opportunities that emerge in addition to a more agile response to emerging risks.

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