

Sensemaking and Complexity in Large-Scale Lean-Agile Transformation: A Case Study from Cisco

Ken Power
Cisco Systems
ken.power@gmail.com

Abstract

For organizations undergoing agile and lean transformation, it can be difficult to get meaningful, actionable insights into progress and impediments. Teams and organizations are best understood as complex adaptive human systems. Understanding what is happening in such systems requires approaches grounded in the complexity sciences and social sciences. This paper describes an approach using complexity science and sensemaking that helps an organization understand its culture, how it is progressing with its strategic initiatives, and the types of impediments that are holding it back. It provides a means of qualitative and quantitative analysis that helps teams and organizations improve. This paper also correlates the experiences of the people in the organization to its goals of being a more agile organization.

1. Introduction

Many organizations desire to undergo a transformation to a more agile, lean-thinking way of working. It is difficult to quantify progress in a meaningful way, even more so for larger organizations. Part of the challenge is that we are dealing with change in complex adaptive systems. As a result, the goals of these agile-lean transformation efforts can become separated from the real goals of the business. We need measurement approaches that consider the system as a whole.

Section 2 presents a brief overview of relevant literature, primarily to provide context. Section 3 describes the research approach, including the specific research objectives of this study. Section 4 presents the main case study. Section 5 provides an analysis of the data collected, and section 6 offers some discussion and insight on the data, including lessons learned. Finally, Section 7 summarizes the conclusions of this study and describes related and future research that builds on this study.

2. Review of relevant literature

2.1. Agile and lean development

Agile and Lean methods in software engineering began emerging in the 1980s. Agile Software Development emerged as an umbrella term in 2001 for a set of lightweight methods that were considered an alternative approach to the overly bureaucratic and ineffective sequential, plan-driven, “waterfall” process that were dominant at the time [1]. The creators of many of these lightweight methods convened in Utah in 2001 to create what became known as The Manifesto for Agile Software Development, or, simply The Agile Manifesto [2]. The teams in this case study use Scrum [3] XP [4] and Kanban [5]. The organization as a whole is on a path to transforming to be a more agile business. One goal of this case study is to help articulate the progress they are making.

A popular practice of Lean is the notion of managers “going to the gemba”, or going to the place where work happens [6]. This is more straightforward in manufacturing, where the work is repeatable and both the work itself, and the artefacts of the work, are highly visible. In software development and organization transformation, the work is much less visible. Work is contained in information, culture, and collaboration between many different entities. There is still value in gemba walks in software development and in transformation efforts, but we need to supplement them. That is part of the reason we use complex adaptive systems (see section 2.2) as a lens through which to view teams and organizations. When dealing with cultural issues and change in complex systems, there is more happening than we can observe in a gemba walk, hence our motivation for using a sensemaking approach (see section 2.3).

2.2. Complex adaptive systems

Dooley notes that “*the prevailing paradigm of a given era’s management theories has historically mimicked the prevailing paradigm of that era’s scientific theories*” [7]. The complexity sciences have emerged as one of

the prevailing paradigms for modern management thinking in general [8, 9]. There are many definitions of complex adaptive systems, with some disagreement between them. Mitchell notes “*perusal of the history of science will show that the lack of a universally accepted definition of a central term is more common than not*” [10]. Human Systems Dynamics (HSD) defines a CAS as a “*collection of individual agents who have the freedom to act in unpredictable ways, and whose actions are interconnected such that they produce system-wide patterns*” [11, 12]. The agents and the system constrain one another, especially over time [8]. Stacey has shown that “*all organisations are complex adaptive systems in which groups and individuals are the agents*” [13]. Agile teams and organizations, therefore, are better understood as complex adaptive systems (CAS) that are self-organizing and have emergent properties.

2.3. Sensemaking in a CAS

Weick quotes Prus [14] in defining sensemaking as “*the meaningful linking of symbols and activity, that enables people to come to terms with the ongoing struggle for existence*” [15]. Sensemaking is a way of exploring the wider system. Ancona advocates making sensemaking a core capability for individuals, teams and organizations “*so that we can break through our fears of the unknown and lead in the face of complexity and uncertainty*” [16].

2.4. Flow

Flow-based development emphasizes a focus on the continuous flow of value. From a management perspective, it encourages managing queues rather than managing time lines [17]. The ideas behind flow-based development originated with the Toyota Production System and have gone on to inspire agile approaches including XP, Scrum and Kanban. Kent Beck defines flow in software development as “*delivering a steady flow of valuable software by engaging in all the activities of development simultaneously*”. This is different to traditional project management approaches that focus on managing timelines and project phases.

2.5. Impediments

Frameworks such as Scrum place an explicit focus on removing impediments, though without defining what impediments are

[3]. This case study uses a framework for helping teams and organizations to see and categorize impediments [18]. In that paper the authors define an impediment to flow as “*anything that obstructs the smooth flow of work through the system and/or interferes with the system achieving its goals*”. The impediments categories identified include extra features, delays, handovers, failure demand, work in process, context switching, unnecessary motion, extra processes, and unmet human potential. The impediment framework, summarized in Table 1, is an input to the design of the sensemaking framework for the case study described in section 4 below.

Table 1. Summary of impediments to flow in teams and organizations

Impediment	Description
Extra Features	Features added without a proven need or valid hypothesis
Delays	Situations in which something happens later than it should, and implies a holding back, usually by interference, from completion or arrival.
Handovers	Incomplete work must be handed over from one person or group to another
Failure Demand	The “demand caused by a failure to do something or do something right for the customer”
Work In Progress	Work that is not yet complete, and, therefore, does not yet provide any value to the business or the customer
Context Switching	When people or teams divide their attention between more than one activity at a time
Unnecessary Motion	Any movement of people, work or knowledge that is avoidable, impedes the smooth flow of work, or creates additional inefficiencies
Extra Processes	Extra work that consumes time and effort without adding value
Unmet Human Potential	The waste of not using or fostering people’s skills and abilities to their full potential

3. Research approach

3.1. Research objectives

The research described in this paper has the following objectives:

- **RO1:** Understand more about the people and culture in the organization.
- **RO2:** Understand broadly, and along multiple dimensions, how the organization is progressing with its transformation to a more agile, lean-thinking business.
- **RO3:** Understand how the organization is doing relative to its strategic objectives, and look for early warning signs, or leading indicators, of success and failure. The organization had five specific strategic objectives for the financial year covered by the period of this research. For confidentiality, they are coded as A, B, C, D, E, and referenced as such in this paper.
- **RO4:** Understand the impediments affecting people in the organization, and look for early warning signs, or leading indicators, of success and failure.

These research objectives are intended to be generalizable, not specific to the group that is the subject of the case study in this paper. As such, these objectives should be of interest to other groups in the same organization, and even other companies undergoing transformation and seeking similar insights.

3.2. Action research

The author used action research as one aspect of the research methodology for this study. Where other research methods treat people, teams and organizations as “subjects” of research, Action Research engages stakeholders as full participants in the research [19]. Action Research provides a way for the people affected by a problem to play a part in solving the problem. In other words, Action Research provides a model for enabling local action-based approaches to inquiry where a goal is to apply small-scale hypotheses to specific problems in specific contexts [20]. This approach compliments agile and lean approaches including Lean Startup’s build-measure-learn cycle, agile’s philosophy of small-scale experiments, the Deming/Shewart Plan-Do-Study-Act cycle, the Sprints in Scrum, or the iterations of XP.

Stringer notes that “*a fundamental premise of participatory action research is that it commences with an interest in the problems of a group, a community or an organization*” [19]. The purpose of participatory action research is to “*assist people to extend their understanding of their situation and to resolve significant issues or problems that confront them*” [19]. For the organization referenced in this paper, the research began with an interest

in the problems of the organization. These are outlined in section 3.1 above (Research objectives). The intent is to assist leaders and decision-makers in the organization to broaden their understanding of their situation – to reveal the system to itself – and to help them identify and resolve significant impediments that confront them.

3.3. Complexity and narrative research

Organizational culture meets our definition of complex adaptive systems. According to Weick “culture consists of characteristic ways of knowing and sensemaking” [21]. The way an organization solves problems or removes impediments is an expression of culture. If we want to understand culture as per Research Objective 1, we need to appreciate that in such systems the relationships are non-linear so the effect or outcome is not proportional to the cause [22]. Looking for a single root cause in such a complex space is unlikely to be successful. Instead, decision makers responsible for the transformation, and designing interventions, benefit from understanding the interactions of agents at many levels. While some causes and their effects can be perceived when dealing with organizational culture, it is impossible to predict what will happen and provide enough understanding to build models and establish causality. Therefore, exploratory approaches are necessary [23].

Narrative research, sometimes referred to as *narrative inquiry*, developed in the social sciences. It is an exploratory research method that involves working with narrative materials of various kinds, some of which might already exist, some of which might be created as part of the research [24]. It therefore provides a way to make sense of behaviors and interactions in complex systems by allowing for continued interactions with the environment and by combining qualitative material from individuals and small groups into an overarching quantitative framework for the whole organization. Transformation leaders and decision-makers can see the big picture, and also have the ability to dive deeper into specific issues for greater insight.

Narrative research approaches complement an agile approach. Both share a focus on empowerment and self-organization, and encourage refinement of the process through successive iterations. The social network stimulation aspect leverages the wisdom of the crowds [25] to create a shared understanding of what is happening across the organization.

Within the frame of action research and case study, this study uses a narrative research approach. The types of narratives we are specifically interested in for this study are “micro” narratives, or small story fragments, as distinct from highly structured narratives.

We could use a number of different tools for capturing and analyzing micro narratives as part of the sensemaking process. Options include pen-and-paper, with manual analysis (as we did for the initial pilot, described in section 3.6 below). We could also use a variety of analysis tools, spreadsheet applications, mind maps, knowledge management, or survey tools. We decided to use a dedicated commercial tool, the SenseMaker® suite [26], as it provided a good natural fit for our needs. As far as we know, there are no similar products in the market.

3.4. Data capture process

The person recording a micro narrative is called the ‘respondent’. The respondent captures data about their experiences, using the following basic steps:

1. Present the respondents with a prompt question that triggers their memory, and has them recall an experience that relates to the subject of interest.
2. The respondent records a micro-narrative of their experience using text, audio or pictures. Most respondents used text, with a small percentage using audio or pictures.
3. Respondents are asked to signify (interpret) their own narrative using a set of triad, dyad, and multiple-choice questions. Section 4.3 below describes triads and dyads in more detail, while sections 5.5 and 5.6 presents an analysis of some of the triads and dyads used in this study.

3.5. Data analysis process

Researchers at Cognitive Edge and Cisco analyzed the data (narratives and self-signified interpretations) independently, and reviewed the analysis together through multiple iterations, and created reports. Data analysis was performed using the software suite.

3.6. Initial pilot study

The overall study described in this paper covers a period of six months. Of that, two months were for an initial pilot study conducting paper trials with groups in the US, UK, Israel, and India. During this phase we

created PDF versions of the framework and had participants work with paper print-outs. The researchers scanned the responses into a set of PDF documents, and used those for initial analysis. The researchers made significant changes to the framework during this period, and eventually settled on the version of the framework that was used in the electronic apps.

4. Case study: sensemaking in an agile organization

4.1. Background to the case

The context for this study is a specific software group in Cisco. The group has more than five thousand people in locations around the world, with major R&D centers in North America, Europe, Middle East, and Asia. The organization develops hi-tech software and solutions, and has been undergoing a transformation to more agile, lean-thinking ways of working and operating. The groundwork for the transformation, and initial pilots, had been underway for approximately twelve months before this project began. Over one thousand people are part of the first wave of the transformation. Approximately 200 people, or 20%, of the first wave participated in this initial study. The goal is to eventually have the full organization participate.

4.2. Context for this study

The project is part of an overall approach to defining a metrics program for the organization. There are three parts to the metrics program. The first part focuses on diagnostics for teams, management and programs. For this part, we use guided self-assessments to help people understand how they are doing with adoption of practices and behaviors that are relevant to being a more agile organization. The second part focuses on flow metrics, and providing visibility into how the work is flowing through the organization. Examples here include throughput, cumulative flow, cycle time and release burn-up metrics [27]. The third part focuses on understanding the organization as a whole, including cultural aspects, communication, agility, impediments, and progress towards specific organization goals. We combine the sensemaking data with the other data to get a holistic picture of the organization. The third part is the focus of the sensemaking project described in this paper.

4.3. The research framework design

This section describes the elements of the sensemaking framework.

4.3.1.Prompt. This diagnostic begins with a prompt question. In this case the prompt asks the respondent to think about a memorable interaction at work, and then tell us about the experience. The telling can be in the form of entering text, recording audio, and/or taking a picture. The respondent is then asked to give their experience a title. Note, some sensemaking approaches ask respondents to record a “story”. We tried that in the initial trials and rollout. As explained later in lessons learned (section 6.3), we discovered that respondents had difficulty with the term “story”, and changed it to “experience”.

4.3.2.Triads. The survey has six triads, each on its own page. A triad is a triangle shape that has three labels, or signifiers. Respondents place their answer to a question within the triangle by moving a circle inside the triangle. Balancing three elements creates a cognitive tension that forces the respondent to find a resolution, and leads to deeper reflection and insights. A sample triad from the framework is shown in **Figure 1**. The question accompanying this triad is “What contributed most to the outcome of your experience?” We designed this triad to help understand the extent to which these three elements contribute to outcomes in the organization. There is a “N/A” option if respondents feel the triad is not applicable to their experience.

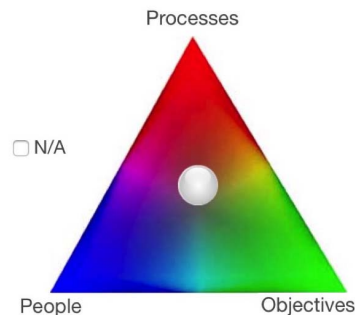


Figure 1. A Triad that asks the respondent to signify their perception of the balance between processes, people and objectives

4.3.3.Dyads. The survey has six dyads. Related dyads are grouped two per page. A dyad is also referred to as a *polarity*. Respondents place their answer to a question on a spectrum between two polar opposite

positions by moving a slider. A sample dyad from the framework is shown in **Figure 2**. This dyad is designed to help us understand the balance between autonomy and control in the organization.

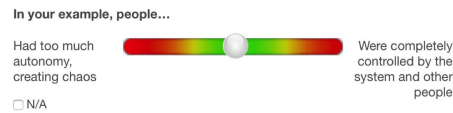


Figure 2. A Dyad that asks the respondent to signify their perception of the balance between autonomy and control

As with triads, there is a “N/A” option if respondents feel this dyad is not applicable.

4.3.4.Other elements. The survey collects information using other elements, including lists of option boxes (select one of many), check boxes (multiple selections are possible), and free text entry fields. These provide information about emotional intensity of the experience, how the experience relates to the organization’s strategic objectives, how common this type of experience is, impediments that made the experience difficult, and people or groups involved in the experience.

We also collect information about the respondent, including which group they belong to in the organization, what they work on, and what country they are based in. Although the survey is anonymous, respondents have the option to provide their email address for follow-up discussions, and to provide any other comments in free text.

5. Analysis

5.1. Impact of the analysis

The data and insights were reviewed with senior leadership, and the broader management team, including coaches, change agents and scrum masters. There is much more data than can fit in this paper, so we present here some of the key insights that are leading to actionable changes in the organization. The data is actively being used by the organization to inform the next phases of the transformation.

5.2. Data perspectives

The overall emotional intensity of the experiences, as determined by the respondents, is shown in Figure 3.

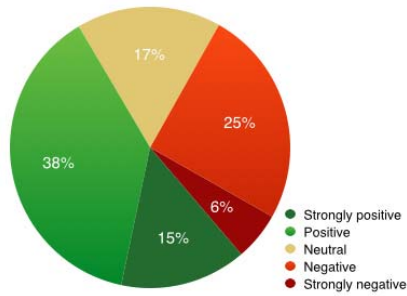


Figure 3. Emotional intensity of the experiences

Respondents perceived 70% of experiences as strongly positive, positive, or neutral, while the remainder perceived as negative (25%) or strongly negative (6%).

Our research revealed that, overall, participants are positive, with a healthily small negative percentage experiences reported. An absence of negativity can be a strong indicator of a conforming, fear-driven culture. That is not the case here. The color-coding in the histograms that follow reflects the emotional intensity of the experiences in each case.

The histogram in Figure 4 shows the proportion of respondents from each country. The majority of responses came from people based in the UK, France, USA and Israel.

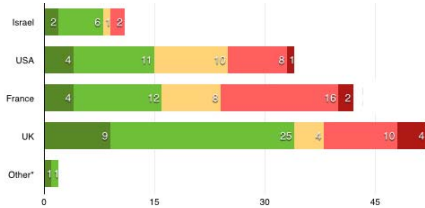


Figure 4. Locations represented in this Study

From the emotional intensity coding we can see that experiences shared by respondents based in the UK and Israel tend to be proportionally more positive than those shared by respondents from France. US-based respondents seem to have more neutral experiences than their colleagues in other locations.

The histogram in Figure 5 shows that the majority of respondents are from one of the engineering groups.

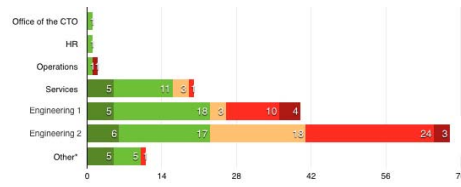


Figure 5. Groups represented in the recorded experiences

People from Engineering Group 2 (46%) and Engineering Group 1 (27%) shared the majority of the experiences. People in Engineering 2 submitted the highest proportion of negative experiences.

The frequency of occurrence of the experiences is shown in Figure 6. This tells us whether the experiences are one-off occurrences, happen rarely, occur sometimes, are quite common, or represent experiences that occur all the time.

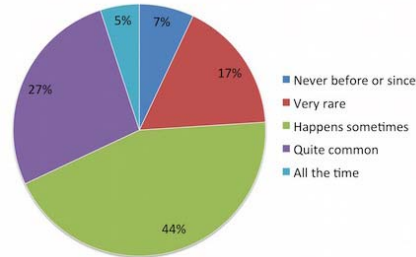


Figure 6. Frequency of occurrence of the experiences

Respondents indicated that 5% of experiences happen all the time, while 7% never happened before. 71% are quite common or happen sometimes. Of that 71% that happen sometimes, Strategic Objective E is the most significant strategic objective associated with the experiences.

There are many possible stakeholders involved in the experiences recorded by respondents. Any individual experience can involve more than one stakeholder. The histogram in Figure 7 shows that managers, directors and engineers were the most featured stakeholders in the recorded experiences.

The majority of experiences involved managers, directors, and engineers. Experiences that involved sales people and product managers tend to be proportionally more negative. There seem to be more positive experiences where subject matter experts, outside people and groups, and suppliers and partners were involved.

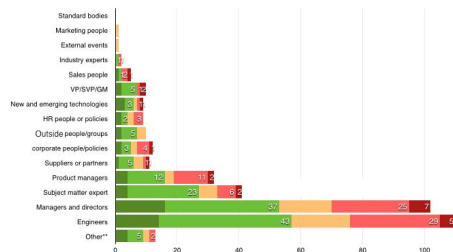


Figure 7. Stakeholders involved in the experiences

5.3. Strategic objectives

The organization had a specific objective to understand the realization of its strategic objects. Five core objectives were identified as part of the organization's strategy. These are coded as A, B, C, D and E in the histogram in Figure 8.

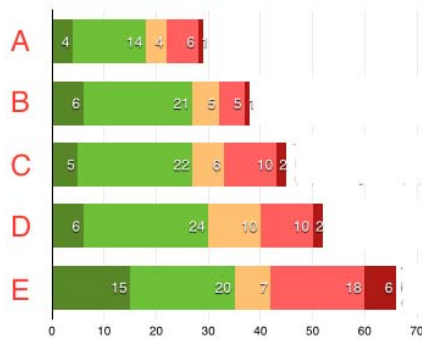


Figure 8. Experience relating to strategic objectives

The majority of experiences relate to strategic objectives E and D. There are proportionally fewer negative experiences that relate to B and A. E has proportionally more negative experiences associated with it than any other strategic objective.

5.4. Impediments

The organization had a specific objective to understand what kinds of impediments made work more difficult for people. The histogram in Figure 9 shows the proportion of how each of the impediment categories is represented in the recorded experiences. Context switching, delays, work in progress, unmet human potential, and handovers seem to be the most common types of impediments making work difficult. A very high proportion of experiences report unmet human potential as an impediment. The majority of cases where handovers were reported as difficulties are

reported positive experiences, reflecting how the impediments were dealt with.

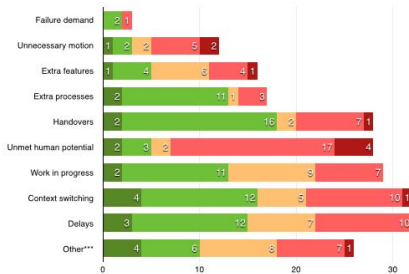


Figure 9. Impediments that make work more difficult

5.5. Analyzing basic patterns: triads

This section shows one example of how a Triad is interpreted. Presenting the full analysis would consume more than the available space in this paper. Figure 10 shows a triad. The dots in the triad show where respondents place their answers. Each dot represents a recorded experience. The color-coding shows the frequency of occurrence of the experience.

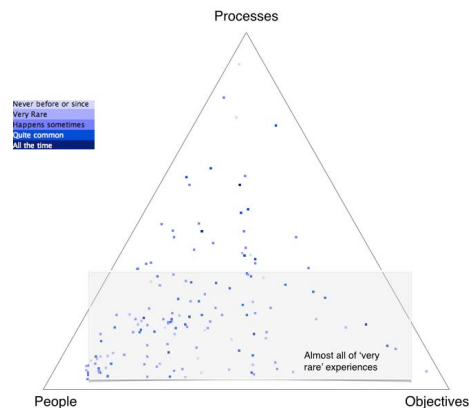


Figure 10. A triad that shows how people, processes and objectives contribute to outcomes

The color-coding of the points inside the triangle correlates to the frequency of occurrence, as described in Figure 6. This indicates an over reliance on people as the biggest contributors to outcomes, which needs to be verified by further research. In 55% of the experiences, people are perceived as the biggest contributors to outcomes. This could be a positive thing, in that people are cooperating to get things done. However, processes and objectives rarely contribute to outcomes. This may be an indication that (a)

the processes and operations are not stable, defined, or efficient enough to support the way people work; and/or that (b) objectives are not clearly communicated or understood.

5.6. Analyzing basic patterns: dyads

The histograms in Figure 11 and Figure 12 show the response to the question “*In your example, what was happening?*”

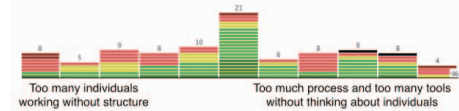


Figure 11. Structure vs. process

Figure 11 shows that respondents tend to be more negative about lack of structure or too little structure than about too much process, while Figure 12 shows that too much change is more likely to be perceived as negative.

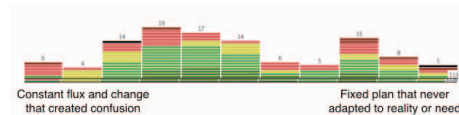


Figure 12. Change vs. following a plan

The histogram in Figure 13 shows the response to the question “*In your example, how often did people connect with others?*”

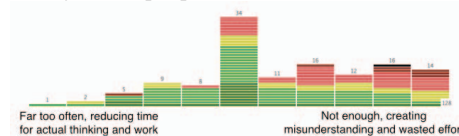


Figure 13. Connection with others

There are very few experiences that report too much connection, but when it happens it is perceived as mostly positive. Experiences where not enough connection are reported are mostly negative.

The histogram in Figure 14 shows how respondents feel about the balance between autonomy and control, as reflected in the experiences they shared.

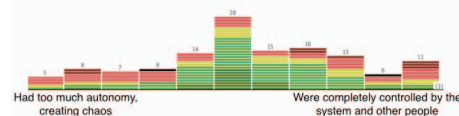


Figure 14. Autonomy vs. control

There seems to be a slight tendency towards too much control, which is mostly perceived as negative. Too much autonomy also tends to be mostly perceived as negative.

The histogram in Figure 15 shows the response to the question “*How often are other people communicating with you?*” There are several examples that report too little communication, and these experiences are perceived as mostly negative.

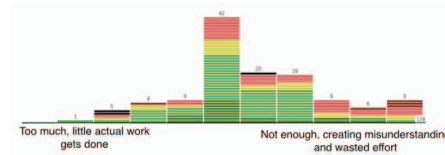


Figure 15. Frequency of communication

The histogram in Figure 16 shows the response to the question “*In the experience you shared, how were strategy and direction relevant to how the problem was handled?*”

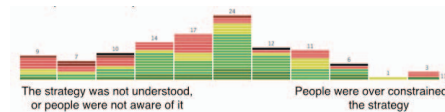


Figure 16. Relevance of strategy and direction

People rarely feel over-constrained by the strategy. It is more common that strategy is not understood or not known. In most cases where the strategy is not understood, the experiences are negative.

5.7. Monitoring

It is useful to monitor responses to a particular question, e.g., impediments or customer interaction. Our framework allows us to monitor a single dyad filter, as shown in Figure 17.

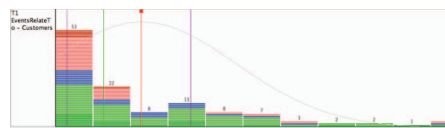


Figure 17. Monitoring customer experiences

For example, we can look at the mean, represented by the red vertical line in Figure 17, and take a snapshot. We can then look at it again in 3 months and see if it has shifted. This is useful input for designing experiments and also shows what kind of shift we have made. It could be that the mean is too far to the right, and we need it to come back again, so we design experiments to move the mean.

5.8. Summary of key insights

These insights have proven valuable:

- Overall, participants are positive, with a small negative percentage of responses.
- While the most common strategic objective is E, it only happens sometimes. If it should be more frequent, the limited examples of quite common occurrences of

E would be a good place to start to make interventions and design experiments.

- While respondents don't have much interaction with sales/marketing teams, the experiences they reported are more negative than interactions with other groups such as subject matter experts. To improve cross-discipline working, examples of positive interactions with sales and marketing will serve as good exemplars for interventions.
- In general, Strategic Objectives A and B are experienced positively. This may be a reflection of the fact that those are largely interactions with other experts.
- Strategic Objective E, is the most abundant issue dealt with and the most polarized. There are more strongly positive examples here, but also the most negative examples. This appears to be the objective in need of the most attention.
- The scale of the negative experiences in which things were made difficult by unmet human potential may suggest that it is strongly embedded in organizational practices. This points to a need to engage people and find more ways to unleash their creativity and potential.

6. Discussion

6.1. Review of research objectives

We can note the following outlined in section 3.1 above:

- **RO1.** The recorded experiences, together with the emotional intensity (section 5.1), help develop a deeper understanding of the people and culture in the organization.
- **RO2.** The initial reports behind this case study provide pointers for taking action to ensure the transformation is a success.
- **RO3.** The study has revealed early-warning indicators around two of the five strategic objectives, and point to the need for action to ensure they are successful. These are discussed in section 5.3.
- **RO4.** The study has revealed the dominant impediments that are making work more difficult for people in the organization, outlined in section 5.4.

6.2. Agility and autonomy

The Agile Manifesto was one of the source documents used as an influence when designing the sensemaking framework. We wanted to understand the degree of correlation

between the values expressed in the manifesto, and the experience of people working in the organization. Interestingly, the study reveals that people perceive there is too much autonomy rather than too little. This points to the need for some enabling constraints and structures to help people be more effective.

6.3. Lessons learned

Some key lessons learned include:

- **Experience v Story.** As noted in section 4.3.1, participants in the early trials expressed confusion about the term "story", and had difficulty conceptualizing a micro-narrative. Often the "stories" were big, e.g., "agile transformation". Others were intimidated by the term "story" and felt that they had to come up with something entertaining and compelling. We found that calling them "experiences" helped get past that barrier.
- **Collecting experiences.** The study has helped to discover various ways to gather experiences. These include integrating narrative collection into team workshops, leadership workshops, and other forums where people are together. At a team level, integrating narrative collection into retrospectives, daily standups and other ceremonies works well.
- **Pictures in the framework.** Pictures need to be simple. We had two pictures in the initial version of the framework (describing end-to-end flow and development lifecycle), where people could signify their experience by dragging and dropping numbers onto the picture. In the end, after paper trials and initial experiments with the apps, we decided to not use any pictures in the framework.
- **Input to coaching plans.** The insights gained through sensemaking are useful input to coaching plans for teams and organizations, and help coaches and change agents to design interventions.

6.4. Limitations of this study

This study represents the first phase of a program to roll out the framework across a large organization. The response rate was high for the target population, however, not all countries and functional groups were represented in this phase. The next phase will include more locations and functions.

6.5. Constraints and pre-requisites

These constraints and pre-requisites that contribute to the success of this type of project:

- This sensemaking project has executive management support.
- It is an integral part of the transformation strategy, not a separate initiative.
- Clarify how the sensemaking project differs from other surveys.
- Engage managers and leaders first.
- Address the risk of the sensemaking project becoming a tool to create a “command and control” environment, rather than a supportive, autonomous, creative one. The rollout of this project included setting that context, and engaged senior leaders and managers directly.

7. Conclusions and future work

This study, and the use of a sensemaking process, has provided valuable insights for the leaders and decision makers in the organization. Those insights, summarized in section 5.8, are leading to actionable interventions in the organization. In particular, a sensemaking approach using narrative research and complexity science helps organizations gain deeper insights into progress on strategic objectives, as well as deeper understanding into the level of organization agility and the types of impediments making work more difficult.

The author is working on modifying the framework for broader rollout across the organization from September 2015. As already noted under lessons learned in section 6.3 above, the author is researching the effectiveness of different methods of gathering experiences in technology organizations. One goal is for sensemaking to be used on a continuous or periodic basis by as many people as possible. The author is currently working on a customer-facing sensemaking project that will be rolled out to select customers. That project builds on approaches described in this paper to gain deeper insight into customer relationships.

References

[1] Highsmith, J.A., *Agile Software Development Ecosystems*, Addison-Wesley, Boston, 2002.
[2] Beck, K., Beedle, M., et al, *Manifesto for Agile Software Development*, 2001.
[3] Sutherland, J., and Schwaber, K., *The Scrum Guide. The Definitive Guide to Scrum: The Rules of the Game*, Scrum.org, 2013.

[4] Beck, K., and Andres, C., *Extreme Programming Explained: Embrace Change*, Second Edition, Addison-Wesley, Boston, MA, 2005.
[5] Anderson, D.J., *Kanban: Successful Evolutionary Change for Your Technology Business*, Blue Hole Press, Washington, 2010.
[6] Womack, J.P., *Gemba Walks*, Lean Enterprise Institute, Inc., Cambridge, MA, 2011.
[7] Dooley, K.J., "A Complex Adaptive Systems Model of Organization Change", *Nonlinear Dynamics, Psychology and Life Sciences*, 1(1), 1997, pp. 69-97.
[8] Snowden, D.J., and Boone, M.E., "A Leader's Framework for Decision Making", *Harvard Business Review*, 2007,
[9] Vasconcelos, F.C., and Ramirez, R., "Complexity in Business Environments", *Journal of Business Research*, 64(3), 2011, pp. 236-241.
[10] Mitchell, M., *Complexity: A Guided Tour*, Oxford University Press, 2009.
[11] Eoyang, G.H., *Human Systems Dynamics Professional Certification Training Manual*, HSD Institute, Cohort 32 - Roffey Park, UK, 2013.
[12] Eoyang, G.H., and Holladay, R.J., *Adaptive Action: Leveraging Uncertainty in Your Organization*, Stanford University Press, 2013.
[13] Stacey, R., "Emerging Strategies for a Chaotic Environment", *Long Range Planning*, 29(2), 1996, pp. 182-189.
[14] Prus, R.C., *Symbolic Interaction and Ethnographic Research: Intersubjectivity and the Study of Human Lived Experience*, 1996.
[15] Weick, K.E., *Making Sense of the Organization, Volume 2: The Impermanent Organization*, Wiley, 2012.
[16] Ancona, D., "Framing and Acting in the Unknown", in (Snook, S.A., Nohria, N.N., and Khurana, R., 'eds.): *The Handbook for Teaching Leadership: Knowing, Doing, and Being*, SAGE Publications, Thousand Oaks, CA, 2012
[17] Reinertsen, D.G., *The Principles of Product Development Flow*, 2009.
[18] Power, K., and Conboy, K., "Impediments to Flow: Rethinking the Lean Concept of 'Waste' in Modern Software Development", *Agile Processes in Software Engineering and Extreme Programming, 15th International Conference (XP2014)*, 2014
[19] Stringer, E.T., *Action Research*, SAGE Publications, Thousand Oaks, CA, 2014.
[20] Denzin, N.K., and Lincoln, Y.S., *Sage Handbook of Qualitative Research*, SAGE
[21] Weick, K.E., and Sutcliffe, K.M., *Managing the Unexpected: Resilient Performance in an Age of Uncertainty*, Wiley, 2011.
[22] Meadows, D.H., *Thinking in Systems: A Primer*, Chelsea Green Publishing, White River Junction, Vermont, 2008.
[23] French, S., *Cynefin, Statistics and Decision Analysis*, Palgrave Macmillan, 2013.
[24] Squire, C., Davis, M., et al, *What Is Narrative Research?*, Bloomsbury Academic, 2014.
[25] Surowiecki, J., *The Wisdom of Crowds*, Knopf Doubleday Publishing Group, 2005.
[26] <http://cognitive-edge.com/sensemaker/>
[27] Power, K., "Metrics for Understanding Flow", *Agile Software Development Conference (Agile 2014)*, 2014