

# Lessons from Iraq for Building and Running SRE Teams

## From the Assembly Line to the Web

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General Stanley McChrystal led the Joint Special Operations Task Force in Iraq in the mid to late 2000s. While in command of the Task Force, he was responsible for transforming an organization that was dominated by Taylorist reductionism into an agile, responsive network that could dynamically adapt and win in the threat landscape around them. In his book *Team of Teams: New Rules of Engagement for a Complex World* [1], McChrystal outlines the key lessons that emerged from that process. The same issues and challenges face Site Reliability Engineers and managers for SRE teams as we cope with the complexity of our own and partner ecosystems.

### The Challenges of Growth in a Complex Environment

As one of the Senior Individual Contributors in the SRE (Site Reliability Engineering) group at LinkedIn, I and the other leaders in the organization are always looking to improve the capabilities and effectiveness of our SRE teams. As our membership, service offerings, and engineering teams have grown over the last few years, we have had to confront new challenges. Figure 1 shows the nearly seven-fold growth in the SRE organization over the last three years. The number of internal services that we support has grown even faster. This rate of growth makes it difficult to keep up with the influx of new personnel, which in turn makes it important to become even more conscious about communication, but some of our key difficulties have arisen because of changes in our physical presence.

In 2013, we were located on a single campus where one could walk from one end to the other in a few minutes. Our SRE organization initially expanded to include a team in Bangalore, India, operating almost completely opposite to Pacific Coast daytime hours, but that was less of a challenge than having our single campus fragmented with the opening of new offices 40 miles away in San Francisco, 10 miles away in Sunnyvale, as well as 3000 miles away in New York City. Suddenly, simple chats with colleagues on other teams required new logistical coordination which, in many cases, ended up choking off the conversations.

Matching the growth in individual engineers, what had been a very simple, limited management framework in 2013 had burgeoned by 2016 into multiple layers that matched the physical separation of the different embedded SRE teams. (LinkedIn's SRE teams are co-located with the development teams that they support, hence the term "embedded.") The separation and fragmentation between the different teams was leading to duplicated effort as well as reduced cohesion of the overall SRE organization.

In this context, and seeking strategies to address these challenges, I ran across McChrystal's book. The approach that he employed in transforming the bureaucratic environment of the US Armed Forces Joint Special Operations Command (JSOC) into an adaptable, agile fighting system mirrored many of the challenges that we were facing with the SRE organization, although on a fairly different scale—for instance, his version of the daily "standup" meeting involved up to 7000 people from around the globe and took two hours, six days a week!

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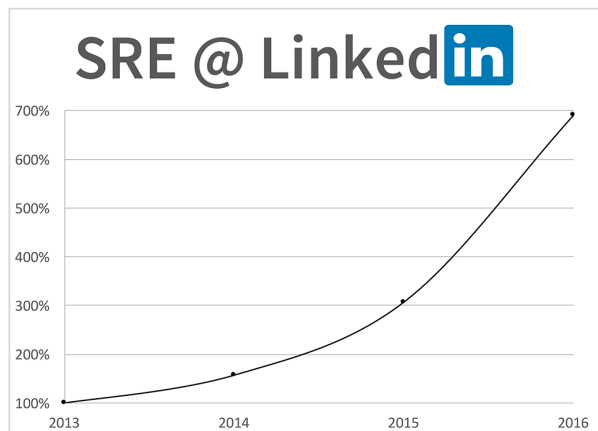


Figure 1: Growth in headcount in the SRE teams at LinkedIn

### Be Careful What You Optimize For

Dating back to the midpoint of the last millennium, people became fixated on the idea of the “clockwork universe.” This principle arose from a mechanical concept related to Newtonian physics and posits that if one knows all of the inputs to a particular system, it should be possible to exactly predict the outputs from that system. Fantastically complex mechanical clocks can be found in town squares across Europe as a testament to this perspective and the importance that it achieved as an organizing principle. Mechanical calculation led to the difference engines of Charles Babbage (circa 1822), which were intended to create the logarithm tables that were used for calculations of many different phenomena. While Babbage’s difference engine was not actually constructed during his lifetime, the plans he drew up served as the basis for a project to build the engine, using metallurgy and capabilities that would have been feasible during his lifetime, which was completed in 2008. The Jacquard “programmable” loom for pattern weaving (1801) was another instance of similar thought toward automating repetitious tasks.

Around the early 1900s, Frederick Winslow Taylor extended the idea of a “clockwork universe” to create the principles of “scientific management.” The key principles of this school of thought are:

- ◆ That absolute, inflexible standards be maintained throughout your establishment.
- ◆ That each employee of your establishment should receive every day clear-cut, definite instructions as to just what he is to do and how he is to do it, and these instructions should be exactly carried out, whether they are right or wrong.

Taylor strictly separated the roles of worker and manager. The manager had five functions: planning, organizing, commanding, coordinating, and controlling. The ultimate incentive for the manager was to gather and centralize more information in order to push more and more efficient directives to the organization,

while the Taylorist worker’s role was two-fold: provide information and await commands. All effort was to be expended in the pursuit of maximum efficiency, and all individuals were to be treated as fungible resources, no different from a bolt or a nail.

“Scientific management’s” rigidly hierarchical and extremely siloed model of operations took the repetition of Babbage’s difference engine and applied it to people. Sadly, the effects of treating people as expendable parts can be seen in the inhumane conditions that characterized the trench warfare of World War I. The scars of that warfare can still be seen across the landscape of Europe today, and the scars of inhumane management practices still plague many companies and individuals.

In the field of computers, the traditional sysadmin role was siloed, often undervalued, and only noticed when something went wrong. It led to the caricature of the BOFH (bastard operator from hell [6]).

### From Complicated to Complex

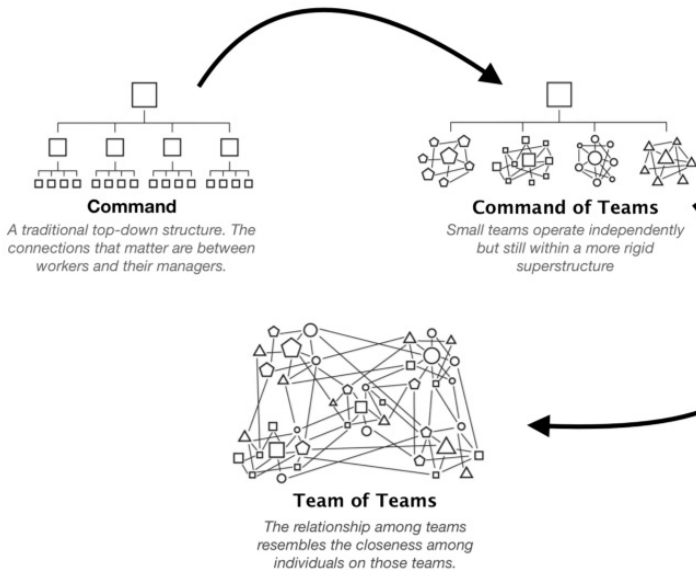
The problems and limitations of the clockwork universe became more evident within the scientific community even as Taylor was making his mark on the management world. Relativity, quantum mechanics, and eventually the atomic bomb revolutionized physics, and the development of chaos theory in the 1970s showed that there is a phase-change difference between the complicated, mechanistic “clockwork” to the turbulent chaos of the modern world, where critical differences arise from imperceptible origins or interactions.

In his book, McChrystal points out that complicated systems can be made “robust,” meaning less prone to failure, by building them up with more of what is already there: for instance, the Pyramids of Giza have survived millennia by being made of masses of stone. To make them stronger, you would just add more stone.

Complex environments, on the other hand, are “resilient” by the nature of the interconnections between their constituent parts. A coral reef is an example of a complex, resilient ecosystem that thrives based on the variety of organisms which share the space. Another example of complex interactions would be the way that a successful soccer team works together. If every team member is only aware of what is happening within their own local area of the field, and, even worse, if “their area of the field” is rigidly defined, then the team has little or no chance of being successful. Whether you are the goalie or a forward, you should have one “job” on the team: to win.

McChrystal pointed out that “to each unit [within the military bureaucracy that made up JSOC], the piece of the war that really mattered was the piece inside their box on the org chart.” To succeed in their mission in Iraq, they needed to overcome the silos. They already had a model of highly effective small squads of operators in the elite military units such as the SEALs and

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**Figure 2:** This diagram from *Team of Teams* illustrates various ways of organizing a command arrangement.

Rangers. The challenge was how to take that “small team effectiveness” and extend it across the organization of JSOC, moving from a “command of teams” to a “team of teams,” and bringing in the adaptability and resilience of a network dynamic at all levels of the organization (see Figure 2).

McChrystal worked to build relationships and trust between disparate services by intentionally seeding key operators into other teams.

At LinkedIn, as our SRE organization rapidly grew, we have had to work on ensuring that we did not end up in silos. The division of our teams across multiple locations has made it somewhat natural for people to focus on those who are physically nearby, so we have instituted a number of initiatives, many organically driven, to break down the barriers that could otherwise occur.

The first strategy that we have found helpful, particularly for bootstrapping new technologies and driving adoption across our constantly growing engineering group, is what we call “virtual teams.” There is a whole life cycle to the process for virtual teams, but generally they consist of like-minded folks from multiple management teams who share a particular interest or passion. As an example, our ELK (elasticsearch-logstash-kibana) environment at LinkedIn is run in a highly distributed manner, but the virtual team helps to guide by staying up to date on new versions and features while also adapting new versions to our internal deployment frameworks.

Another strategy that we use is based on our cultural value of transformation. As part of transformation, we think that learning is a never-ending aspect of work and life. Besides multiple

tech talks that are provided by different teams and individuals every week, within the SRE organization we organize a full day every month of deep dive sessions into different technologies that SREs use. While not everyone in the organization is able to participate every month, this provides a common forum for people across the organization to meet together and improve their skills.

We have grown to the point where there are enough post-mortems every week that we need to start drawing out higher level patterns, so a weekly “postmortem roll-up” provides this opportunity. We are also starting a program of inter-team rotations, where an engineer will spend half a quarter (six weeks) working on a different team. These different pieces are all helping us to avoid becoming a “command of teams” and maintain a “team of teams” dynamic.

### Shared Awareness

Traditionally, and especially in the formulations of “scientific management,” only particular people “need to know” information. Compartmentalizing information is a very effective way to create divisions and separations within an organization based on the simple difference of who is “in” and who is “out.” Predicting exactly *who* needs to know a particular piece of information turns out to be a huge problem. In the war in Iraq, McChrystal found that opening up the flow of information was critical to the effectiveness of the teams of intelligence analysts and operators on the ground. He cites the problems that GM faced in dealing with their famous ignition switch recall because of compartmentalized information within the company. Simply no one had enough of the picture to recognize and take action quickly enough to avoid the deaths and subsequent public outcry leading to Congressional hearings that finally shone light on the underlying problem.

Most practitioners of DevOps and Site Reliability Engineering have recognized that measuring and monitoring is critical, but making the data available to everyone who can benefit from it is equally critical. It’s important to take as broad a view of “everyone who can benefit” as possible because you never know how two seemingly independent issues may have a common contributing cause.

In *Social Physics* [2], Alex Pentland points out, “It is the idea flow within a community that builds the intelligence that makes it successful.” Pentland expands upon that to identify both exploration of new ideas as well as engagement with concepts as critical determinants for effective idea flow. Engagement with the community, both learning from and giving back to, is one of our (LinkedIn SRE) keys to a robust organization. The company’s strong tradition and culture of transparency at all levels also reinforces the practice of sharing information widely and freely.

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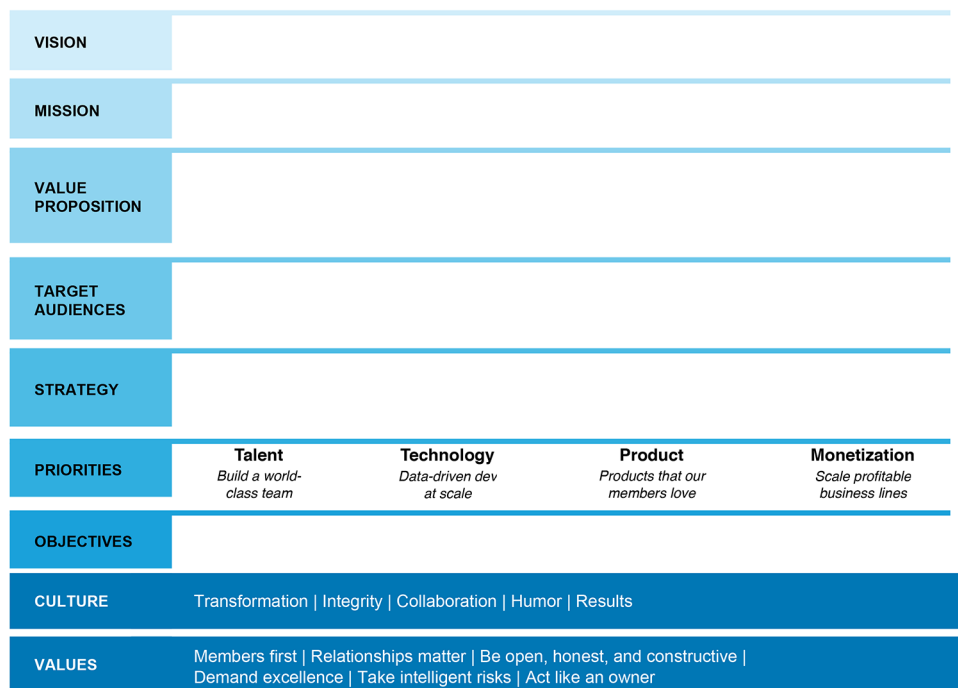


Figure 3: LinkedIn vision-to-values framework

### Empowered Execution

Teams of teams who have the shared understanding of the challenges and opportunities that face them are like a soccer team whose members are all paying attention and reacting to the situation across the entire field. But that team can still fail to be successful if the players have to check with the coach before they ever kick the ball. The example is a bit ludicrous, but many companies operate that way. Teams must be empowered to take action and make decisions on their own. It is critical to push decision-making as close to the action as possible.

A great example of a team responding on their own without the need for external guidance is illustrated in the *Site Reliability Engineering* chapter on incident response [3]. In the positive portrayal of effective incident response (“A Managed Incident”), the team of people know how and when to engage, have a good understanding of the different roles that need to be covered, and carry out the incident response empowered by that scaffolding.

Sidney Dekker, who is one of the foremost authorities on accident causation and human error, points out: “When we find that things go right under difficult circumstances, it’s mostly because of people’s adaptive capacity; their ability to recognize, adapt to, and absorb changes and disruptions, some of which might fall outside of what the system is designed or trained to handle.” It is key, when considering automation and process design, to keep in mind the importance of people’s adaptive capabilities. This applies to SRE teams building automation as well as to software developers building externally facing products.

In the example of the JSOC in Iraq, McChrystal cites the demonstrated value of these principles, which he terms “eyes on, hands off,” as leading to an increase in both quality and speed of execution. When they had previously attempted via a “robustness” strategy to just “work harder,” the team was able to raise their raids per month from 10 to 18, but by changing to an empowered team of teams, they increased the number of raids by a factor of 17, accomplishing 300 raids per month with only minor increases in personnel.

Peter Seibel, in his gigamonkeys blog [4], makes the case for investing in engineering effectiveness in proportion to the size of an engineering organization by modeling the multiplying effect of the right investments. We have found that SRE teams can catalyze improvements in site benefits that outstrip the investment of talent in the SRE teams themselves.

### Leadership

The last major theme that McChrystal covers in his book has to do with what he learned about leading an organization which was made up of teams of teams. The metaphor that he adopted was to “lead like a gardener,” which means that each touchpoint is an opportunity to encourage, guide, and strengthen the culture of the teams. The role of leaders became focused on providing the appropriate “good ground” for the groups.

At LinkedIn we have the benefit of having the core cultural tenets consistently reinforced throughout the organization. They provide touchpoints when making decisions. In proposing any new initiative, people are expected to go through what we call a “vision to values” framework, illustrated by Figure 3.

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Every initiative is evaluated through the lens of the organization's values and culture, and tested against the priorities. This applies to external, member-facing services and features, and also to every internal initiative.

Another part of leadership is planning for the future. Phil Libin, founder of Evernote, points out the "lesson of 3 and 10" [5] that he learned applies to technology companies, especially when growth is prolific: roughly every time something triples, the systems need to be refactored in order to continue working well. In our case, the SRE organization has grown by a factor of seven over three years, and many pieces have had to be adjusted. We have had to become much more intentional about collaboration and maintaining relationships that used to be organic. Our site traffic and membership have increased significantly. Our deployment velocity has gone from deploying 500 services once a month (each) to over 5000 deployments per month. We've expanded the number of locations with engineering presence and the number of datacenters that we actively serve traffic from.

As leaders, whether in the management ranks or among individual contributors, it is still critical to be inspiring people to work together to accomplish a shared vision. As a reader of *login*, just like the attendees at SREcon16 Europe where this talk was initially given, you are a leader in your profession. Accept the challenge and consider what effect you have among the people you interact with: *What are you inspiring others toward?*

This article is derived from a talk given at SREcon16 Europe in July 2016.

### References

- [1] S. McChrystal (with T. Collins, D. Silverman, C. Fussell), *Team of Teams: New Rules of Engagement for a Complex World* (Portfolio / Penguin, 2015).
- [2] A. Pentland, *Social Physics: How Social Networks Can Make Us Smarter* (Penguin, 2015).
- [3] B. Beyer, C. Jones, J. Petoff, and N. Murphy, "Managing Incidents," in *Site Reliability Engineering* (O'Reilly Media, 2016).
- [4] Peter Seibel's blog: [gigamonkeys.com](http://gigamonkeys.com).
- [5] Rule of 3 & 10: <https://www.sequoiacap.com/article/the-rule-of-3-and-10/>.
- [6] Wikipedia, "Bastard Operator from Hell," last modified on Aug. 22, 2016: [https://en.wikipedia.org/wiki/Bastard\\_Operator\\_From\\_Hell](https://en.wikipedia.org/wiki/Bastard_Operator_From_Hell).