Managing Complexity in Technology Development: Planning as an Act of Improvisation

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Abstract

This is a preliminary report on the primary author's ongoing fieldwork study with IBM eServer pSeries Hardware Development team. This study will be based on the Fall Plan--a planning process that the Development team goes through every year. As a result of this study, the organizational life of the pSeries Hardware Development team will be described from the perspective of complex adaptive systems theory and recommendations will be made to improve the team's understanding and management of organizational dynamics.

1. Introduction

Fieldwork is a method of research where a researcher goes "into the field" to describe a particular group's way of living. The fieldwork method is part of the originality of this study. Fieldwork is conducted by finding emergent codes and categories in the fieldnotes from observations and interview data collected over time. These emergent codes and categories are then used to analyze and interpret the meaning of observed events.

An organizational fieldworker is a researcher who goes into an organization to develop an understanding of its culture from the inside out [1]. Fieldworkers provide insights into how everyday routines constitute organizational processes and structures. They realize this by examining what organizational members do and how they talk about what they do.

This report is based on the primary author's ongoing fieldwork with members of the IBM eServer pSeries Hardware Development team. She has been shadowing and interviewing members of the pSeries Program Management team as well as members of functional management teams to observe social aspects of technology development.

The topic of this report is a particular planning process that this group goes through every year--the Fall Plan. Consequently, the data of this report come from organizational practices of the pSeries Hardware Development team. It should be noted that observation and interview data from other groups in IBM (e.g., Software Development, Sales, Marketing) would result in the description of the Fall Plan from a different perspective. Additional data from other groups would also give a more complete picture of this planning process.

2. Current understanding of the Fall Plan

2.1. What is the organizational activity around the Fall Plan?

The Fall Plan is an annual, division-level event that describes what will be developed in the upcoming tactical time period in IBM. As a result of the Fall Plan process, divisions in IBM commit expenses and revenue for their development programs to the corporation. Organizational members describe the Fall Plan as a proof process designed to help implementation by

establishing connection between budget and product commitment for the coming year. From the vantage point of the pSeries Hardware Development team, the following points are negotiated and committed during this planning process:

- Product definitions with marketing
- Financial parameters with finance
- Budgets for programs and functional organizations with development executives.

Members of eServer pSeries Hardware Development team describe the Fall Plan in widely varying ways:

> "It is a proof process to ourselves through which we come to believe that we have made the right decisions."
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> "This process is designed to help cope with the question of implementation. It is about making provisions for resources on which everybody agrees."
>
> "It is the process through which the business, with its variety of disciplines, attempts to establish a connection between the budget and commitments for the deliverables of the coming year, predominantly, and of years beyond, to a certain extent."

The Fall Plan officially begins with the publication of a document at the beginning of fall. This year it was announced on August 29, 2001 and was 110 pages. From the perspective of the eServer pSeries Hardware Development team, the Fall Plan is supposed to function to set deadlines, commit human and material resources and posit goals for the development of the coming year's products.

The Fall Plan indicates a negotiation process during which the money allocated by the General Manager to Development is distributed among programs. After the publication of the official document, negotiations follow between the Brand Organization (whose function is to keep on top of market trends) and Development. These negotiations focus on creating a balance between what Brand wants to produce and what Development requires to deliver the requested products within the boundaries of a stable budget.

Discussions with a member of the Development team resulted in the following representation of the components of the Fall Plan:

The *Icon Roadmap*[1] that comes from the Brand Organization is commonly referred to as the "Wish List." This list represents the Brand Organization's view of what the business should be producing and therefore how much money would be distributed between SG&A (Sales, General, and Administrative) and Development. The Brand Organization also decides what percentage of the money will be spent in what area of development, allocating x amount of dollars to hardware and y amount of dollars to software.

After receiving the wish list from the Brand Organization, Development begins a process of content optimization to arrive at an *Executable Roadmap*. This optimization process involves doing sizings for proposed projects, crossing off icons from the Roadmap, changing definitions of products, moving dates on schedules, etc. As a result, a tradeoff happens between technological content and extrapolation on what that technology will bring in terms of revenue.

The iterative negotiations between the Brand Organization and Development are influenced by various factors. The *budget*, which is initially determined by the corporate finance community and later distributed to different areas of Development by the Brand Organization, is a bounding factor. Then there are factors that are controlled by the Development: *Critical skills, skills,* and *processes and tools*. Critical skills are those that are specifically necessary to complete a particular project. Skills refer to the general set that needs to exist to maintain the business. Processes and tools make up the infrastructure for the organization. *Space* needed to make the work happen is another important and accountable resource. *Technology* represents the building blocks to choose from in order to execute the Fall Plan.

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[1] An "icon" represents a product in this context.

The Fall Plan is about providing feedback for the wish list/ Icon Roadmap. This feedback is based on the requirements coming from all these resources, or constraints, in order to come up with an executable roadmap "that optimizes revenue in selected market segments within the budget."

2.2. How do organizational members describe the Fall Plan?

This year, after the 110-page Fall Plan document came out, one organizational member spent hours in meetings to make arguments about "what page 10 in the Fall Plan meant." Page 10 gave a list of priorities for the different programs to be developed in the following year. This list indicated where the priorities would be for the distribution of resources. If the Fall Plan worked as a fixed agreement, or a blueprint of what was to be built when, why would organizational members argue to determine which programs were going to be given priority for resources?

Organizational members do not view the Fall Plan as a blueprint according to which they conduct their activities. If the Fall Plan functioned as a blueprint, it would create a stable structure for the upcoming year's development programs. Instead, the Fall Plan is used to give voice to competing views of what needs to happen. Members use this process to negotiate what they need to achieve. The goal of this negotiation is not to come to a strict sense of where things should be. The goal is to mark the boundaries under which things could be defined.

The "fluidity" of the budget is an important aspect of the Fall Plan. The budget is not fluid in the sense that the size of the budget would change significantly. However, the distribution of the budget among different programs depends on the larger context of the business, like market dynamics and technological changes, as well as the local context of the organization, like dynamics among players. For example, when it comes to decisions about prioritizing programs, executives would be biased in one direction or another.

One organizational member defined this process as a combination of top-down and bottom-up management. The "top" says, "We wish to build these computers." Then the functional teams (teams that work to build distinct functions to go into systems) look at the Fall Plan assumptions and give feedback to the top saying, "In order to build those computers, this type of work needs to be done." This member argued that the whole process was designed to push for this kind of back and forth. This back and forth is also seen as one of "education."

Functional managers take this planning process as education about what area of the business the top management wants to invest in and where their value propositions are. On the other hand, the feedback from functional managers about the specific requirements for building a particular product helps the top management establish goals for the organization's business. The distribution of resources takes place as a result of this bi-directional communication.

Members of the pSeries Hardware Development team describe the Fall Plan as an organizational process that is there to ensure that right decisions are made about what the business can produce within a stable budget. In this sense, we can argue that the Fall Plan is carried out as an effort of coordination among disparate groups in IBM because it is important for establishing a sense of agreement among these groups.

2.3. Present perspective: Planning as response to the anticipated

Metaphors that have been used to describe organizational planning processes have traditionally come from non-living systems, like the metaphor of blueprint from architectural construction. These metaphors have served the desire for fixed order and control in organizations. This desire often becomes a handicap for organizational members, because organizations are complex living systems with emergent order and uncontrollable trajectories.

Research in a number of fields--information theory, biology, organization science, communication and anthropology--have given us a new sense of how processes in complex systems work. For example, according to the view of organizations as complex systems, organizations function in an environment where boundaries are open to the point of being indiscernible. This makes it difficult to predict the future state of an organization and to understand organizational planning as an orderly, linear process. Organizations are always influenced by external effects that are beyond the control of internal members.

The fundamental problem with architectural metaphors is the supposition that spontaneity and order are mutually exclusive categories. When we take the view of organizations as complex systems, we see that spontaneity and order actually exist together. This insight is especially manifest in organizational planning processes like the Fall Plan.

2.4. Present objective: Achieving coordination through the Fall Plan

The current practice of the Fall Plan has problems to be expected based on a Newtonian understanding of organizations. Traditionally, organizations have been examined as if they were functioning in an orderly and predictable world (a la Newtonian physics) governed by rules, job descriptions, organizational charts, etc. According to this view, following specific procedures leads to specific consequences. In this framework, carrying out an organizational process is contingent on achieving a set of criteria.

We can argue that the following criteria are achieved when actions are coordinated in an organization:

- Clearly defined task
- Distinct roles
- Pre-established goals
- Specifically assigned supervisors
- Clearly defined resources
- Necessary amount of relevant information

When we observe the organizational activity around the Fall Plan, we see that none of these criteria are achieved, even though team members describe the Fall Plan as a process that should serve coordination of action. There are two possible answers to this puzzle. One is that the organizational activity around the Fall Plan is not being carried out correctly, because the more the team members are trying to achieve coordination of action, the more energy it takes and the less it works for that purpose.

The other way of looking at this puzzle is to approach the Fall Plan as a platform for processes like sensemaking, conflict resolution, alignment of power, negotiation and improvisation instead of coordination. The complex adaptive systems view of organizations helps us bring these organizational processes to the foreground of analysis.

3. Understanding of organizations as complex adaptive systems

3. 1. Definition: The dynamic nature of organizational life

Complex adaptive systems theory brings a new perspective to the study of organizations. According to the theory of complex adaptive systems, organizational members function as an indivisible whole by:

- Building overlapping goals
- Sharing images of the organization
- Creating connections among organizational roles, tasks, and functions.

Taking a complex adaptive systems view helps an observer see the *nonlinear, emergent,* and *self-organizing* nature of everyday life in an organization [2]. Organizational activity is created by nonlinear interactions among organizational members. Particular members develop unique patterns of interactions as they collaborate on a project. These patterns play an important role in shaping the final product. Events that result from patterns of connections among different members, like surprises, multiple competing demands, interpersonal battles, etc make up the emergent aspect of organizational life. Organizations are self-organizing entities. The pattern of organization that develops from local interactions among members, like informal networks of managers, has a significant effect on the course of ongoing activity. We can understand the inherent dynamism--manifested in nonlinearity, emergence, and self-organization--of organizational life when we observe it from the viewpoint of complex adaptive systems.

Also, one of the fundamental characteristics of complex adaptive systems is that the relationships among elements that make up the system are more important than the individual elements in determining the behavior of the system. In this sense, organizational activity around a planning process is fundamentally about working out a set of relationships. We can gain a more realistic understanding of organizational processes like the Fall Plan when we focus on the dynamic nature of organizational life and the significance of relationships among organizational members.

3.2. New perspective: Planning as an act of improvisation

Improvisation is an emerging metaphor in studies of organizations. At first, improvisation strikes as a far-fetched metaphor for planning activity. This results from seeing improvisational performance as a completely spontaneous and intuitive act and disregarding its reliance on an established boundary.

When we see organizations as complex adaptive systems, we begin to understand how a planning process, like the Fall Plan, becomes a platform for improvisation rather than a platform for coordination of anticipated behavior. The following definition by a scholar of jazz improvisation is helpful to understand the improvisational characteristics of an organizational process like the Fall Plan:

"Improvisation involves reworking precomposed material and designs in relation to unanticipated ideas conceived, shaped, and transformed under the special conditions of performance, thereby adding unique features to every creation" [3].

According to this definition, improvisation is not an "off-the-cuff" activity. Improvisers perform within the bounds of a given framework. Still, it is not possible to predict which transformations will lead to the creation of something novel and coherent. The act of performing these transformations determines the form of the final work. When we become preoccupied with spontaneity of improvised performance, we miss the fact that practicing your limits within an established order is a key element in improvisation.

4. Question to be answered as a result of this study: What makes the Fall Plan a better platform for improvisation instead of coordination?

Organizations' emphasis on maintaining order and control creates a handicap to understand planning as a process of innovation and creativity. The understanding of organizations as complex adaptive systems with fundamentally uncontrollable trajectories helps us think about planning in a different way. If we accept the fact that it is not possible to predict the future state of a complex system, then we can understand that planning means dealing with the unforeseen, or working with the unexpected. In other words, planning is an act of improvisation.

Observations of the eServer pSeries Program Management team during the Fall Plan have shown noticeable characteristics of jazz improvisation in management activity during this planning process. Managers work like jazz improvisers, because they simultaneously discover targets and aim at them, create rules and follow rules [4]. As managers engage in their everyday activity, they do not know what the specific final results of their work will be. However, they do know which directions are not right to achieve the desired results. Similar to improvised performance, management activity during the Fall Plan is controlled within the given structure of the Fall Plan but it can not be predetermined.

Improvisation in a jazz band involves interaction between an emerging musical pattern and formal features of the act of composition. These formal features of improvisation are

- the underlying theme,
- previous interpretations of the theme,
- the individual player's own logic of interpretation,
- responsiveness of the instrument,
- other musicians,
- the audience.

A complete analysis of the primary author's ongoing fieldwork will show how these formal features of improvisation are enacted by the members of the pSeries Hardware Development team during the Fall Plan. This analysis will be based on fieldnotes written up in the form of daily entries and episodes composed of sequences of events.[2] By showing the improvisational aspects of organizational activity during the Fall Plan, this study will offer

1. a dynamic rather than static description of the pSeries Hardware Development team's organizational life;
2. suggestions for improvement on various aspects of the Fall Plan, like documentation, preparation, decision-making, executive guidance, team dynamics and social interaction.

5. References

[1] Schwartzman, H. B., "Ethnography in Organizations," *Qualitative Research Methods: Volume 27*, Sage Publications, 1993.

[2] McDaniel, R. R., M. E. Walls., "Professional Organizations Stuck in the Middle: A Complex Adaptive Systems Approach to Achieving Organizational Turnaround in Adverse Situations," *Advances in Applied Business Strategy*, vol. 5, pp. 131-152, 1998.

[3] Berliner, P. F., *Thinking in Jazz: The Infinite Art of Improvisation*, The University of Chicago Press, 1994.

[4] Weick, K. E., "Improvisation as a Mindset for Organizational Analysis," *Organization Science*, vol. 9, no. 5, pp. 543-555, September-October 1998.

[2] See the addendum for a sample episode.

Addendum

The following sequence of events happened during the first week of this year's Fall Plan (September 3-7, 2001). I will use the unfolding of this sequence as an example to describe the kind of improvised performance that takes place during the Fall Plan. Main participants in this sequence included:

Anthony:	Program Manager of a 2003 Regatta product
Bruce:	Director of UNIX Hardware Development
Cindy:	Director of Engineering Software
Dave:	Director of eServer Hardware Design
Eddy:	Director of eServer Software Design
Frank:	Vice President of eServer Design
Greg:	Chief Engineer (Hypervisor Architecture)
Henry:	Distinguished Engineer (eServer Software Design)

The following events during the first week of the Fall Plan were initiated by an email note Anthony received from Greg on August 31, the Friday before September 3. This note was Greg's response to Anthony's ongoing argument about keeping a new, sophisticated function out of the 2003 Regatta product because of mismatches on the timeline. Greg's note came as an unexpectedly charged "end of discussion" dismissal to Anthony's argument. A series of email notes followed Anthony's response to Greg. Soon the correspondence went past and above Anthony to schedule a meeting on Tuesday, September 4 among directors for a discussion of product definition.

Anthony's role in the organization gives him the overall responsibility for the process of developing the 2003 Regatta product. Therefore, he has the broadest view of all the factors affecting this process. A significant point about the scheduling of the Tuesday meeting was how quickly the email correspondence went up to a level above Anthony. In his view, this signaled an effort to eliminate his participation and input in the discussions. With this in mind, he had himself invited to the meeting.

At the meeting on Tuesday, Bruce, who is the director responsible for the development of all machines under two product lines, raised different versions of the following question: How could the investment in the development of a technology for one product be justified if it meant risking the shipment of a whole family of products for the year of 2002?

Anthony's ongoing argument, which was dismissed by Greg, was based on certain facts pertaining to a significant mismatch in the timeline and availability of resources. This mismatch indicated that there was an unjustifiable risk involved in investing in a new technology for the 2003 product. Making this investment would seriously disrupt the current line of development. Anthony pitched these arguments to an audience of Bruce, Dave, and Cindy in the conference room, with Eddy, Greg and Henry on the phone.

During the meeting, Bruce asked how, given Anthony's objections, the risk in investing in a new technology could be justified. Eddy, Greg and Henry, who supported this new technology, listed its advantages, among which was the opportunity it creates for common service between product lines. However, they did not respond to Anthony's most salient argument, which was that the deadlines and resources for the development of the new technology could not be made to converge smoothly with the ongoing development process.

At the end of the meeting, Dave expressed, by his looks and tone of voice, discontent with Anthony's version of the facts about the risk involved in making a new technology part of the 2003 product. He underlined the necessity "to put numbers on the table and executize to show why it does not work" by formulating cost assumptions for different options. Cindy also asked for a list of options so that her team could do a sizing based on the checkpoints on the timeline. She repeatedly expressed the need to create clear and crisp guidelines concerning scheduling, content, and cost for two different options. The first of these options was what was originally described in the Fall Plan. The second option had variations. At the end, a follow-up meeting was scheduled before the end of the week to go over the specifics of these two options based on data to be gathered by Anthony and his team.

In Wednesday's "Plans and Status" meeting, Anthony asked his team what he had been asked to do at Tuesday's meeting—"go and get data to show what it costs." He wanted projections from his team concerning the number of people and machines they needed if they were to proceed with the new technology option. This was an executive command that presented the development team with a dilemma. On the one hand, their view was that the new technology was unjustifiable and undoable. On the other hand, projecting figures would be a significant advance towards actualizing the new technology option. Anthony spent an hour

explaining to his frustrated team why they had to do a sizing. He started out with an account of Tuesday's meeting. When his account seemed to increase his team's confusion about the rationale behind the demand for a sizing, he got up to draw a diagram on the board about the current debate over the Fall Plan. That did not work very well, either. Then he tried "shifting metaphors." He compared what they were asked to do to "working a mathematical proof backward," in order to understand "What has to happen to get to a particular point?" When objections continued, he raised his voice noticeably to tell them he needed the sizing to be completed before his presentation to the executives on Friday.

On Friday, September 7, Anthony's executive overview summed up the risks involved in adding a new technology to the definition of the 2003 Product. Dave and Cindy were in the conference room and Eddy and Henry were on the phone for this meeting. Anthony described the already existing challenges to the team because of late machines and unavailability of resources. Under these circumstances, investing in a new technology for 2003 might mean losing all the revenue for 2002.

As Anthony went down the list of items in his overview, he gave completion dates and bring-up durations to show the size of the risk of adding a new technology. Dave was listening to Anthony's listing of reasons for "why it would not work," with a frozen expression of frustration on his face. His voice sounded more serious and impatient each time he challenged Anthony's assumptions.

Eddy objected to Anthony's projections about feasibility saying that "information originally asked for" was not there. Eddy added a comment about how difficult it was to rely on the engineering software team to complete even what was already in the plan. Cindy did not take this comment lightly. Her loud response to Eddy added to the already increasing tension in the room.

Anthony had the information Eddy was referring to in the slides following his executive overview. However, before he got to the details on these slides, Dave broke his frozen expression to say, in a loud, agitated voice, that Anthony's overview was not even close to what they could take up to the "Big Boss" (Development General Manager). Anthony's argument about the effect of the shortage of people and machines on his schedule was, Dave opined, unacceptable. Dave made it clear that there was "nothing to be swizzled" about the 2003 Product as it was described in the Fall Plan. In order to generate revenue, they needed everything specified in the Plan and more. Dave told Anthony to "go fix it!"

Cindy summed up what needed to be done to make Anthony's pitch presentable to the Boss in two main action items: 1) Stabilize what is in the Fall Plan, and 2) Work on the feasibility of the second option with the new technology. The participants agreed to work on the Fall Plan definition the following week, and on the second option the week after that. They also concluded that technical leads needed to be included in these discussions.

Dave turned to Anthony one last time and said that Anthony's pitch should be put together in a way that would show the Boss, "We (the development team) lifted up every rock." He told Anthony to base his pitch on answering

- What does it take to build what is asked?
- How soon can I make it happen?

Dave also advised Anthony to go over his pitch with Frank before it went anywhere else. It had been almost an hour since Anthony began taking blows to his presentation. He kept his upright posture the whole time. The strain in his face was evident. He blinked twice and said, in a faint but deep voice, "Okay.. I'll tee it up for you..."