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Phenomenological Examination of Project Delivery Leaders Navigation of Project Complexity

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Abstract

The future project environment is expected to remain increasingly complex and ambiguous. This requires project delivery leaders to develop and grow their cognitive proficiency and expertise persistently. For majority of the involved project delivery leaders, the project complexity is a lived experience. In this conceptual study, we used phenomenological examination of project leaders' coping mechanisms on the challenges of complex project delivery to produce cognitive model and guiding principles for the navigation of project complexity in practice. To navigate the analysis and interpretation of the data, the study used the Understanding, Perception and Action Taken (UPA) model, a three-fold knowledge structure, developed with a rationale that if complexities in projects are better understood by project participants, it often creates the foundations for other actions to be taken. The results provide understanding of project delivery leaders' perceptions of project complexity and ability to assess it for a given project. The full outcome are principles suitable for navigating and managing complexity. The results of this study can assist complex project delivery leaders to develop greater insight into optimal management of increasingly complex projects.

Subject Areas

Project Management, Project Management and Strategy

Keywords

Competency Model, Lived Experience, Macrocognitive, Phenomenology, Project Complexity, Project Management

1. Introduction

By the year 2027, project-oriented economic activity worldwide is estimated to increase to $20 trillion, which would employ approximately 88 million people in the field of project management; however, only 35% of the projects initiated are successful [1]. Stakeholders considerably impact on project behaviour. Project behaviour in project management is "about explaining and anticipating successes and failures" [2]. In 2004-2006, a network of researchers devised the concept "Rethinking Project Management" (RPM) [3]. The research topic "project complexity" was at the top of the list of five recommended directions for research in project management.

Project complexity is a fascinating research area in which there are many shoulders to stand on and many viewpoints to consider. Research and practice have demonstrated the significant role complexity, uncertainty, and chaos serve in our projects and project environments [4]. The concept of complexity in various fields was proposed by Edmonds [5] and defined as "that property of a model which makes it difficult to formulate its overall behavior in a given language, even when given a reasonably complete information about its atomic components and their inter-relations." Baccarini [6] describes complexity as "the state of being involved and intricate." This is attributed to the fact that it includes several interrelated variables relevant to a study. Complexity is a measure of the number of possibilities [7], and complex projects are usually difficult to understand due to their uniqueness. From the perspective of the people working in projects, complexity is something which is perceived or experienced, including both negative (difficult to understand, to foresee and to keep under control) and positive aspects (emergence) [8] [9]. According to Patil & Patil [10], complexity is one of the essential effects of management actions and has an immense effect on the project progress.

To achieve successful project management, it is imperative to have a thorough understanding of project complexity [11]. Project complexity may be described by the complication of a project characteristic because of the involvement of various interrelated project components [12] [13]. A structured review by Luo *et al.* [14] presented the contributions of influential factors and categories in project complexity, from the period 1996 to 2016. Many descriptive frameworks and models such as the one proposed by Chi *et al.* [15] have been published over the last two decades research in project complexity. The common layout is a multidimensional construct. According to San Cristóbal *et al.* [16], the importance of complexity to the project management process is widely acknowledged for several reasons: (i) it influences project planning, coordination, and control; (ii) it hinders the clear identification of goals and objectives of major projects; (iii) it can affect the selection of an appropriate project organization form and experience requirements of management personnel; (iv) it can be used as criteria in the selection of a suitable project management arrangement; and (v) it can affect different project outcomes (time, cost, quality, safety, etc.). Literature on project

management [17]-[25] provide us with a wide range of conceptions and recommendations for succeeding (nevertheless sometimes failing) in situations of growing complexity and raised interesting assertions about the competencies of successful project managers. The research literature on project complexity is vast and diversified. Literature review shows that most dimensional frameworks of project complexity are often descriptive and perceived. These two project complexities are needed when the purpose of the research is to understand a given project or to provide managerial guidance. Kinnamon and Carasco [26] claimed that managing and leading are not synonymous. Managing involves directing others to accomplish a task or objective, while leading is aimed at influencing the direction, action, and opinion of others [26]. Project managers will need to ensure that they have broader range of competencies [27] attending to both technical and relational competencies" [28]. In a complex project environment, "the competences of the project management team must continuously evolve" to keep pace with the demands of cooperation, competition, and innovation [29].

Remington *et al.* [30] and Thomas and Mengel [4] concluded with the request of: "…research to explore project managers' competencies in the view of project complexity." Klein *et al.* argued that "as cognitive mechanisms adapt to complexity in task, team, and environmental demands, they become functionally integrated to support the specific types of complex cognitive work required" [31]. Developing a better understanding of project leaders' cognitive elements and relationships in complex work domains and how it is acquired is therefore a research challenge. This paper takes on that challenge and states the following research questions:

- *What are the experiences of project leaders who successfully managed projects without significant failures despite complexity?*
- *How do project leaders cope up with the challenges of project stakeholders' pervasive impact on project behaviour?*

The goal of this study is therefore to discover and explore important ways of thinking that can project complexity management hand-in-hand with proficiency: macrocognitive skills dimensions using project managers' lived experience as research design tool with data analysed through the lens of complex systems theory.

The remainder of this paper is structured as follows: Section 2 presents the literature study on project complexity and Understanding, Perception and Action Taken (UPA) framework as an analytical and empirical container. Section 3 briefly describes phenomenological methods and focuses on introducing participants of the study and data collection process. Section 4 layouts the analysis of transcripts of phenomenological interviews and evaluation of the findings in the context of project complexity management. Section 5 presents the conclusion.

2. Literature Review

The research literature on project complexity management is vast and diversi-

fied. This section presents the selection of papers viewed as relevant for the endeavor of this paper.

2.1. Theory of Project Managerial Complexity

While there is no commonly accepted definition of project complexity, many authors [14] [32] [33] have promoted the definition proposed by Vidal *et al.* [9]. Their definition states that: "Project complexity is the property of a project which makes it difficult to understand, foresee and keep under control its overall behavior, even when given reasonably complete information about the project system" [9]. Fioretti and Visser [34] defined project complexity as the inadequacy of the knowledge needed to understand and determine the outcomes of a project. Project complexity interacts with the effectiveness of project planning, potentially resulting in both positive and negative contingency effects on project completion time [35]. A complex project is one that exhibits several attributes to a degree, or level of severity, that makes it enormously difficult to foresee project outcomes, to control or manage project [30]. Complexity the authors suggest, "influences project planning and control, hinder the clear identification of goals and objectives, affect the selection of an appropriate project organization form, and can even affect project outcomes." Project complexity is difficult to evaluate correctly. San Cristóbal *et al.* [16] argue that "an understanding of project complexity and how it might be managed is of significant importance for project managers because of the differences associated with decision-making and goal attainment that are related to complexity." According to Edmonds, many models of complexity of projects "tend to be formulated with quite specific purposes in mind" [5]. Based on a review of 420 different publications, Bakhshi *et al.* [36] found three dominant schools of thought within the construct of complex projects: the PMI perspective, the System of System (SoS) perspective, and the Complexity Theory perspective. Daniel & Daniel argues that complexity focuses on interactions producing unexpected effects that cannot be explained or deduced, and on processes that generate unpredictable change in systems [19]. After extensive and thorough literature reviews, a framework of five categories for project complexity was suggested by AlKheder *et al.* [37] consisting of technological complexity, organizational complexity, environmental complexity, goal complexity and cultural complexity. The "technological complexity" investigates the function of technology by studying tools, differentiation, and interdependencies. The focus of "organizational complexity" was on various organizational components, such as stakeholders, structures, and processes. The "goal complexity" highlighted well-defined project objectives and possible ambiguity. The "environmental complexity" considered multidimensional aspects such as market dynamics; and the "cultural complexity" accounted for participants' various backgrounds and opinions. In a structural equation modeling (SEM) inspired study, Azmat and Siddiqui [13] categorized project complexity into seven dimensions: context, size, diversity, autonomy, connectivity, emergence, and belonging. The authors discovered that autonomy had the highest influence in

characterizing project complexity (coefficient: 0.85) followed by diversity (coefficient: 0.784), size (coefficient: 0.739), connectivity (coefficient: 0.662), belonging (coefficient: 0.652), and context (coefficient: 0.529).

2.2. Anticipatory Thinking and Actions in Project Complexity

According to Flyverbom & Garsten [38], anticipation is part of organizational attempts to manage their future affairs and shape their surroundings. According to Butz *et al.* [39], anticipation focuses on the impact of a prediction or expectation of current behavior. Anticipation in the context of this study refers to preparing for a range of future developments. Anticipatory action refers to the act (behavior), including actual decision making; internal preparatory mechanisms; or learning that is dependent on predictions, expectations, aims, or beliefs about future states [40]. Anticipatory action such as foreseeing, foreshadowing, or forecasting future events if learned is the best secret weapon of efficient project leaders. It has gained increased currency to engage with far-reaching project complexity challenges. Anticipatory actions are not only about predicting the future or expecting a future event but also about changing behavior (or behavioral biases and predispositions) according to this prediction or expectation.

Anticipatory thinking is a critical cognitive skill for successfully navigating complex, ambiguous systems in which individuals must analyze system states, anticipate outcomes, and forecast future events [41]. Anticipatory thinking is a fundamental human activity for both individuals and groups. Anticipatory thinking or sense making as Weick [42] called it often takes the form of explaining events and diagnosing problems liken to a retrospective process. According to Rhodes & Ross [43], the ability to look forward in order to take a future decision or action called anticipation has always been a part of the design process. Anticipatory thinking is a cognitive process and through reflective observation and conversations establishes a reality through practice. Anticipatory thinking is the ability to prepare in time for problems and opportunities [31] [44]; an ability to prepare to deal with future challenges in the form of either problems or opportunities [44]; it often takes the form of explaining events and diagnosing problems liken to a retrospective process [42]; it can take the form of formulating expectancies about future events [45]; it also means preparing for something [46] [47] and pertains to change, that is, to a sense of the future [48]. As Mosier and Fischer [49] stated, anticipatory thinking is the "what-if" component of deliberative thought. Klein *et al.* [31] characterize anticipatory thinking as "…the process of recognizing and preparing for difficult challenges, many of which may not be clearly understood until they are encountered…" Measuring anticipatory thinking is particularly challenging because the process does not directly result in the creation of measurable artifacts. Practitioners often use information where available to identify warnings, anticipate a spectrum of possible outcomes, and forecast likely futures in order to avoid tactical and strategic surprise [41].

2.3. Framing the Understanding, Perception and Action Taken (UPA) Model

Numerous definitions and characterizations of complex cognition, complex cognitive work, and complex tasks can be found in the research literature. However, these definitions and characterizations are typically tailored to a particular study and used to define a variable or the focus of the research. In this research, we adopt the Understanding, Perception and Action Taken (UPA) model proposed in (Amaechi, 2013) [50]. Using a three-fold knowledge capability structure, Amaechi (2013) [51] proposed that there are three basic concepts to complex project management capability with these being (1) understanding; (2) perception; (3) action taken, and (4) feedback loop environments (**Figure 1**). The phases are not mutually exclusive. The reasoning for developing and highlighting these concepts is that complex project management requires an empirical container that as the situation evolves, results are evaluated, and new decisions are made that continually reinforces or realign the vision according to reality. This is the context of March [52], foundational work which suggests that "innovation and related organizational processes always involve 'the exploration of new possibilities and the exploitation of old certainties.'" UPA represent how individual characteristics and dispositional factors could influence anticipatory thinking in complex project management. The feedback loop is vital to guiding an anticipatory learning process as the process of anticipatory thinking of the context. The requirement for action is linked to the constant exchange with others. According to Rhodes *et al.*, for design organization or team to establish anticipatory capacity, new competencies are needed [53]. The UPA represents identified qualities of anticipatory thinking and necessary components for building anticipatory learning models.

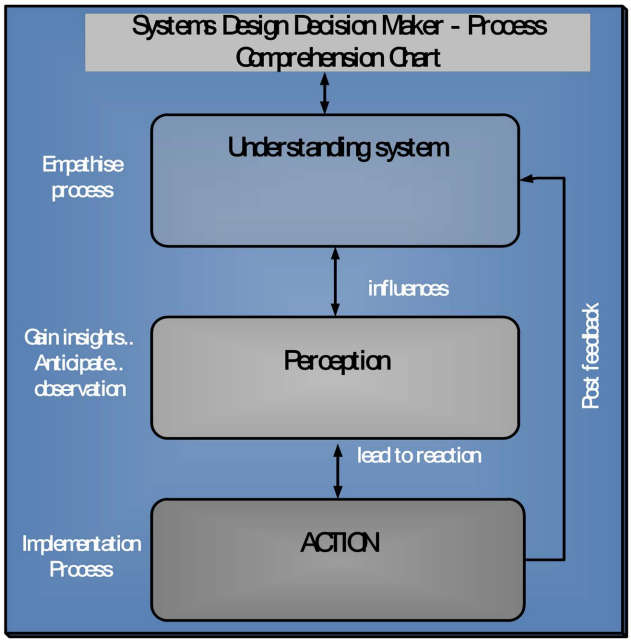

Figure 1. Three-step procedure of the complexity management model [51].

The maximum potential of the model inspired systems can be fully exploited in terms of proactive decision making and decision delivery via an anticipatory action/feedback loop. The UPA model views management team as an evolving system that formulate strategies by anticipating-planning, classifying, observing, preparing, coping, accepting, developing, selecting, adopting, adapting-reflecting, learning, and exploiting various combinations of capabilities. They assess the system behaviour based on their previous experiences. From that perspective, there is need to acquire information and knowledge that can be used to sense a comprehensive context in space and time and infer future-oriented actions based on prescription of the future state of their context.

3. Materials and Method

3.1. Research Design

This study is focused on capturing descriptions of the "lived experience" of leading projects. This research was conducted using participants from three complex system development and management organization. The primary methodology was phenomenological research design. Qualitative phenomenological study is a method that attempts to understand the perspectives of participants and physical or social realities (Colaizzi, 1978; Hennink, Hutter, & Bailey, 2020) [54] [55]. Phenomenology study finds meaning through experience. According to the phenomenological perspective, scientific method is but one interpretive technique that can be used to learn about the world as it is experienced and understood by us. The aim of phenomenology is to attain an understanding and description of the structures of human experience [56]. As Saunders & Budd suggests; phenomenology as a research method is used to describe the essence of experiences from participants with expertise in specific fields [57]. The approach seeks reality in individuals' narratives of their experiences of and feelings about specific phenomena to produce in-depth descriptions of these phenomena. It is the aim of a researcher with phenomenological approach to identify the essence of human experiences as described by participants in the study [58] [59] [60]. It places value on research methods that do not impose artificial structure or simplify the research space, instead seeking to reveal the inherent complexity of human experience as it is lived. According to Stienstra, phenomenology acknowledges that (a) meaning emerges against a background of past experiences, that enables us to anticipate the future, that (b) we gear ourselves to what is most needed, and (c) even incorporate "other things" through which we engage [61]. In this study, perceptions as provided by project leaders are the main evidence analyzed and interpreted. This means interpreting how people interpret their experiences, construct their world, and create meaning [62]. As defined by Boyce & Neale [63], the study is qualitative involving intensive individual interviews with a small number of by project leaders to explore their perspectives on a particular idea, program, or situation. To check the internal consistency the data were subjected to reliability analysis.

3.2. Participants of the Study and Data Collection

Participants in our context are those who with the willingness to give a detailed description of their lived experiences on their organisational practices. Previous study described in Vogus and Sutcliffe [64] model describes middle managers as "translators and enablers" who can reinforce and refine organisational practices. Therefore, it was decided in this study that middle managers would be a logical place to gauge the view of operational processes related to the UPA capability potential concepts. Therefore, middle managers based throughout the organization were targeted for the research program. Twenty participants were initially contacted and ten chosen reflecting diverse backgrounds [65] and still within a study suggestion of 5 - 25 individuals [66], where unique information from the same phenomenon can be dissected and outlined.

In the collection of the data for the study, the researcher conducted pre-interview focus group workshop, an in-depth interview with purposefully chosen seven (7) participants which include notetaking, observations, and audio-video recording. The observation method enables the researcher to see how the different approaches were reflected in the normal workday and how external circumstances influenced involvement with project problems. The data collection process, in general, assured that the principle of listening and deeper understanding was applied. The pre-interview workshop provided opportunity for the researcher and the participants to discuss and understand complex adaptive system (CAS) characteristics. Ethical consideration was insured before the actual in-depth interview was conducted among the participants. The key principles of ethical issues by Kaiser [67] that consent, and confidentiality shall be obtained and observed. For the written interview data collection, participant would first the read definition per each individual CAS characteristics and then for each item in the survey write the response that most accurately describes their confidence in their current level of effectiveness.

The questions were structured to reflect the three sections of the UPA model as listed below:

Understanding	*In your project, what have you been doing well that is driving progress towards your vision?* *In your project, what could you start doing that would drive progress towards your vision?* *In your project, what should you stop doing that is not driving progress or detracting from progress?*
Perception	*In your project, what have you been doing well that is driving progress towards your vision?* *In your project, what could you start doing that would drive progress towards your vision?* *In your project, what should you stop doing that is not driving progress or detracting from progress?*
Action Taken	*In your project, what should you stop doing that is not driving progress or detracting from progress?* *What do you do in response to the complexities they have identified?*

A purposeful sampling strategy was used to select project management executives who have leadership roles as key informants. All participants came from two global IT consultancies specializing in procurement and change projects with a no monetary compensation for completing the study. Participants participated in socio-technical design and project management assignments, which spanned all stages, from idea generation to solution implementation. Due to the busy schedule of participants, a pragmatic approach was favored to get them for the interview. A calendar invitation was subsequently sent out inviting the professionals to participate, and all agreed. The interview duration was between 45 minutes and 60 minutes and the researchers assured that essentials themes were captured and well-defined. Demographic characteristics were similar across the two consultancies. Participant mean age ranged from 28 to 62 years. The work experience of the participants ranged from 8 years to 46 years. Of the total 20 participants, 75% of participants were male. Five MSc program executives, twelve BSc project managers and software architects, and three PhD program directors participated in the study. Further, the participants understood that all interview information would remain confidential and that their identity anonymous by following stringent data collection, storage, and coding procedures. Thus, for reasons of privacy and confidentiality, the names of the participants will not be disclosed and instead, WTN1 for interviewee 1, WTN2 for interviewee 2 and so on were used.

3.3. Analysis of Data

Considering this is a phenomenological study, the analysis of the data was done using Colaizzi's method as explained fully in Speziale and Carpenter [68]. The process requires that:

1) Each transcript should be read and re-read to obtain a general sense about the whole content.

2) For each transcript, significant statements that pertain to the phenomenon under study should be extracted.

3) Meanings should be formulated from these significant statements.

4) The formulated meanings should be sorted into categories, clusters of themes, and themes.

5) The findings of the study should be integrated into an exhaustive description of the phenomenon under study.

6) The fundamental structure of the phenomenon should be described.

7) Finally, validation of the findings should be sought from the research participants.

With the above-mentioned steps, responses through the transcriptions were analyzed for significant meanings through open coding, categorizing meanings through axial coding, clustering, identifying emergent theme or themes, and lastly, coming up with a narrative out of the findings supported by pieces of previous literature and studies. As noted by Polkinghorne [69], in phenomenological research, the researchers' own reflections are a part of the research process. Thus, the analysis of findings involves a reflective process in which the re-

searcher presents a detailed description of his or her experience. In addition, as suggested in (Worthen, 2002) [10], validity in phenomenological studies is not expressed as the capacity to generalize but as a general principle by demonstrating that the data material was collected in a thorough and trustful way, the analysis was rigorous as it assessed alternative competing meanings, and the steps taken to develop knowledge statements or findings were demonstrated.

4. Results and Discussion

Presented in this section were the experiences of the study participants, their insights, and discernments as well the concepts that emerged from the information gleaned through the focus group discussions. This was presented based on research questions identified.

4.1. Analysis of Behavioral Data-Data Constitution

The analytic process started as early as during the first interview. The interviews were formed as a dialogue between the participants and the researcher. The meaning of what was said was interpreted, verified, and communicated during the interview and after the interview. This meaning was pursued and clarified, and sometimes the participants interpreted their own told stories. The interview material was constructed in an interpersonal relational interaction and the development of the dialogue demanded an analysis of what was said to allow the dialogue to proceed. The transcription process was also a form of analysis. During the transcription the researcher took notes of what he interprets as interesting, surprising, puzzling, or common.

Step 1—Listing and Preliminary Grouping

A horizontalization process was broadly applied to the participants' experiential descriptions to ensure a comprehensive listing of relevant statements and expressions were identified. Each relevant statement was assigned to a descriptive label to parse and categorize the data for further analysis. After conducting the preliminary grouping process, 98 statements were identified, and these statements represent non-repetitive significant statements.

Step 2—Reduction and elimination

With the broad and generally defined horizons coded for each transcription, the reduction and elimination phase of the data analysis process was to determine invariant constituents. The invariant constituents are the unique and essential units of meaning that captured the textual qualities of the experience. This is what supported the understanding of the participants' perspectives. Different tests in the form of both analytical and evaluative reflective questions were applied to each of the coded expressions from step 1 to extract the invariant constituents. Analytical reflection according to (Cowan 2006) [70] "reflects on how things are done, and evaluative reflection is a process which leads to the making of a judgement in relation to a set of values or criteria, and one in which the judgement often leads to a consequent decision." In that perspective, the following tests were used in this study:

- *Does it contain a moment of the experience that is a necessary and sufficient constituent for understanding it?*
- *Is it possible to abstract and label it?*
- *Does it indicate possible necessary conditions leaders should create for innovation to flourish?*
- *To what extent does the research foster critical reflection on theory while they engage in practice?*
- Does it *enhance anticipatory capacity of project complexity management organization?*
- *Does it indicate project leader's readiness or capacity to participate in anticipatory modeling?*

Expressions meeting these criteria were coded as the essential horizons of the experience. Otherwise, the expression was eliminated. At the end of the reduction and elimination procedure, different invariant constituents were extracted (see Table 1). The invariant constituents were coded as free nodes using exact descriptive terms designed to enhance step 3 (clustering and thematising) process.

Table 1. A summary of the invariant constituents.

	Invariant Constituents
1	*This was my first project as a system development team manager where development team members are scattered around the globe.*
2	*Important to reduce lack of access and improve situational awareness.*
3	*Much of the project design and planning work undertaken through a multidisciplinary technical working group that was established early in the project has been shown to be particularly effective.*
4	*Whatever good that you build with one team member carries on too many, many more as each of you goes out and form new relationships.*
5	*Team members from designers to developers work side-by-side and have input during each stage of the analysis and construction processes.*
6	*What was helpful and has been very productive is establishment of simple rules that every member of the project team has to know about on joining the project.*
7	*What I notice on my first four months of taking up the job was that it can take lots of listening and interacting before you can move to that next level where you have a relationship with the team that is two-way.*
8	*We have people in New Delhi, USA, Europe with different time zones challenges.*
9	*At final analysis most of the issues and requirements making up the system and project environment are of different level of complexity.*
10	*Order is created in a system without explicit hierarchical direction.*
11	*People can and will process information, as well as react to changes in information. Strive to create the conditions; the outcomes will follow.*
12	*Although expertise can contribute but is neither necessary nor sufficient to assure success.*
13	*It is therefore essential to recognize and acknowledge that every team member is unique and must be understood as an individual.*
14	*There are always confusion and uncertainty at first, then clarity. To succeed, you have to create an environment where people can fail without consequences.*
15	*You encourage and thank people for doing what they are actually paid to do. Imbuing an ownership mindset and not just empowerment is important.*
16	*We are always expecting the requirements to change before the end of each project, and I always expect that I will lose one of the core team members at some point before the end of the development.*

Continued

17	*All my project team members have access to the company global knowledge management systems, and we have regular brainstorming and ideation sessions.*
18	*Most require serious coordination, multiple perspectives and organised responses.*
19	*There are always different perspectives in most issues due to interacting together.*
20	*All opinions were valued. I encourage every team member to get in the habit of always searching for the 2nd and 3rd right answer. Never stop at the first right answer is an expected attitude in our team.*
21	*Making an effort to understand the current capabilities and learn has been very helpful.*
22	*Helping others to experience what you have experienced so they can pass it on, basically resulting to an unintended consequence.*
23	*Every ideas/creativity was welcomed. I had to keep finding ways to influence and encourage the team.*
24	*Would have like even more interactive meetings and assignments. I encourage my team as a group and as individuals to generate inspired ideas by exploring many possible solutions.*
25	*Most often plans are developed at the lowest levels and are then passed on to each next higher level.*
26	*I ask and encourage my team to ask powerful questions, use tools and exercises to get people out of the box.*
27	*Swarm behaviors are the norm, and every team member can become catalysts for actions.*
28	*We are deliberate in incorporating training and skills development in our new service/process projects.*
29	*Members of a development project team has learned to share the same vision about what to achieve, how to achieve it, and why.*
30	*I encourage newly qualified project managers that most projects are really complex, and it is essential to organize your thoughts and assumptions about your current and future projects is a way to see which past and current events they think were most significant and might recur.*
31	*Project management is an activity of anticipation. We all encourage engaging the whole system in order to harness the intelligence and creativity of all its members. Although expertise can contribute it is neither necessary nor sufficient to assure success.*
32	*I encourage ownership of tasks and I stand ready to get to grips with an issue as soon as you have the gut feeling that a process may not work.*

4.2. Selected Individual Textual Descriptions

The participant textual description captures the participants' unique perceptions or insights of the decision-making while determining the appropriate response to managerial complexity issues. The participants' written interviews (questionnaire) forms were reviewed to develop the individual textual descriptions. Examples of the textual descriptions or quotations from the interview are:

Textual Description Summary for Participant #**WTN1**

> *"I made the decision to focus greater attention on the development process rather than on the system that team will eventually produce. This was one step in my attempt to move from requirements-centric instruction to value-centric development instruction."*
> *"I would say the global nature of the system development project (for instance the data architectural and modeling teams are based in UK, interface/dashboard team in India, etc) afforded me the opportunity to remove myself from the main stage and into a position where I can observe the entire system."*
> *"With agreed rules in place, increasingly I have learned to drop principles of line-of-sight management instead trusting my team to do their work and focus more on the overall results."*

Textual Description Summary for Participant # **WTN 2**

"The inconsistencies in the regulatory directives and the internal directorate interpretation of such directives affect the success of the project. It means that timing is everything. Therefore, designing into the development processes the ability to close temporarily and reopen when more information can increase a project's value and can mitigate the problems that are associated with poor timing."
Members of a development project team tend to share the same vision about what to achieve, how to achieve it, and why.

4.3. Relevance and Implications for Project Complexity Management

In the search for explanations of project complexity, complexity theory becomes evident. Cooke-Davies and colleagues suggests that adopting an approach that recognizes projects as complex adaptive systems means that people-understanding them, motivating them, communicating with them-become the fundamental tools available to the project manager [8]. To properly manage complexity, project managers must know how to seize the opportunities emerging from complexity and to know how to avoid or at least diminish the negative effects of complexity [9] [71]. The invariant constituents were indexed against a pre-defined coding scheme based on consistent associations and contextual relationships. The coding scheme was developed based on complexity science characterisation. As the author considered the words used by the project leaders and conceptualisations of complexity characteristics, imaginative variation was employed as a phenomenological tool to expand understanding and appreciation of this step.

Overall, complexity mapping revealed several unique themes listed in **Table 2** (see column Theme Description) revealed during the clustering and thematizing procedure and each were identified as the core themes of the experience informed by project complexity characteristics. The identified core themes (Category-Theme Description) are therefore the necessary complexity thinking knowledge, skills and abilities required for success in managerial complexities decision-making as perceived by the project managers. The list is a definition of complexity learning in projects required by project leaders.

From **Table 2**, we can see from the mapping that some invariant constituents fit under more than one core theme, whereas others were specific to just one. This multiple mapping is not surprising as the principles are inter-dependent sub-theories or ideas that cannot be, nor should they be, easily separated. This observation, in itself, is an indication of complexity-principles that are interdependent with actions. Based on the individual textural description, a description of the participant's experience is created that attempts to depict the underlying reasons for the experiences and identifies the thoughts and feelings associated with the experience.

We returned to selected behavioural attributes based on the phenomenological data to try to understand exactly what the leaders' roles were in bringing about the transformation if they did not originate the idea, construct the vision,

Table 2. Mapping of the invariant constituents to core themes identified.

Theme Description	Invariant Constituents
Adaptive	This was my first project as a system development team manager where development team member is scattered around the globe. Swarm behaviors are the norm, and every team member can become catalysts for actions. Every ideas/creativity was welcomed. I had to keep finding ways to influence and encourage the team. All opinions were valued. Project management is an activity of anticipation. We all encourage engaging the whole system in order to harness the intelligence and creativity of all its members. Although expertise can contribute it is neither necessary nor sufficient to assure success.
Simple rules	Important to reduce lack of access and improve situational awareness. I learnt that allowing an environment conducive to renewal and team culture that encourages creativity has helped my projects successes. Would have liked even more meetings/interactions/assignments. It is essential to recognize and acknowledge that every team member is unique and must be understood as an individual.
Self-organization	Much of the project design and planning work undertaken through a multidisciplinary technical working group that was established early in the project has been shown to be particularly effective.
Emergent	Whatever good that you build with one team member carries on too many, many more as each of you goes out and form new relationships.
Interaction	Team members from designers to developers work side-by-side and have input during each stage of the analysis and construction processes. There are effective team non-linear interactions. We are always expecting the requirements to change before the end of each project, and I always expect that I will lose one of the core team members at some point before the end of the development.
Learning	What was helpful and has been very productive is establishment of simple rules that every member of the project team has to know about on joining the project.
Difficult to control	We have people in New Delhi, USA, Europe all with different time zones. As a project leader, I am prepared and never hesitate in acknowledging obvious conflicts and uncertainties.
Unintended consequences	Order is created in a system without explicit hierarchical direction.
Collaboration/ Decentralized control	People can and will process information, as well as react to changes in information.
Open boundaries	Confusion and uncertainty at first, then clarity. We subject projects during their early stages to an effective rational decision process that assesses whether or not to proceed.
Emergent	You encourage and thank people for doing what they are actually paid to do. I have learned to adopt a design approach through a process of diverging to explore possibilities, and converging to the ones that meet the needs of the project stakeholders and the project requirements
Learning/path dependent	All my project team members have access to the company global knowledge management systems, and we have regular brainstorming and ideation sessions. Lesson learned on each project are always accumulated
Anticipation	Most require serious coordination, multiple perspectives, and organised responses. We are deliberate in incorporating training and skills development in our new service/process projects. Encouraged newly qualified project managers that most projects are really complex, and it is essential to organize your thoughts and assumptions about your current and future projects is a way to see which past and current events they think were most significant and might recur. What I notice on my first four months of taking up the job was that it will take lots of listening and interacting before you can move to that next level where you have a relationship with the team that is two-way. I am always on the lookout for signals either from my project stakeholders or team members such as attending the regular status meetings, being unusually often on sick leave or avoid contributing to discussions and their tone of the conversation in the project team getting louder and more aggressive.
Co-evolution	There are always different perspectives in most issues due to interacting together. We follow a process that manages the co-evolution between problem formulation and solution generation. Our project management team is integrated with the design team; the result is that it enables easier understanding of the problems when they occur and to be able to offer potential solutions quicker.

Continued

Diversity	All opinions were valued. I encourage my team as a group and as individuals to generate inspired ideas by exploring many possible solutions. At final analysis most of the issues and requirements making up the system and project environment are of different level of complexity.
Purposefulness	Making effort to understand the current capabilities and learn has been very helpful. Team envisioning and preparing for design solution of current complexity challenge and for future challenges for active strategy I push for in my team. Project leaders must follow the path of purposefulness in their leadership. Demonstration of honesty, enthusiasm and dedication are all crucial if the project is to succeed. Every team member must live according to the project purpose and hold each other accountable. Members of a development project team tend to share the same vision about what to achieve, how to achieve it, and why.
Flexibility	Helping others to experience what you have experienced so they can pass it on, basically resulting in an un-intended consequence.
Self-organization	Most often plans are developed at the lowest levels and are then passed on to each next higher level. As a team, we planned our project training requirements taking into consideration what we know of the situation to date, our understanding of the changes expected over time is likely to entail, what may happen as a result and finally what we must do as a team to still have a success in our project.
Team coordination/ engagement	Most team members understand the relevance of sending messages to other stakeholders before those messages were requested. Project leaders must create stable, invisible, assumed relationships between project team and project challenges enabling common practices and outcomes. Consideration of the actions and reactions made by various stakeholders as they interact with each other throughout the project lifecycle.
Stakeholder landscape	Stakeholders to involve and how to involve them and involve them effectively, and when to involve them. Stakeholders have a significant and pervasive impact on project behaviour (i.e., successes and failures).
Improvisation	Flexible responsiveness across a wide range of situations.
Metacognition	Project leaders and stakeholders should have the capability to monitor and manage one's own cognitive activity.

and inspire others to follow, using the three categories of "*Understanding", "Perception" and "Action Taken"* as the building block (an interactions model that enables one to understand, analyse and manage better every aspect of project complexity).

4.3.1. Understanding Competencies

The first thematic or competency category that emerged from the data was labelled, *Understanding*. For an anticipatory learning model, understanding plays an important role in delivering the data used to generate context anticipatory action. The category pertained to the key components of complexity thinking that enabled the project managers to understand the project environment. In such a scenario, a single aspect of the present situation was rapidly recognized as having the potential to lead to a problem or need in the near future. These systems (projects) are dynamic, adaptive, and self-organizing where observable patterns emerge because of the interactions between elements rather than a predefined pattern or fixed hierarchy. **Figure 1** below contains all the core themes (competencies and frequencies) that emerged under this category. This research identifies 8 main factors that provide a lens through which project leaders can find a clarity of focus and enable project complexity understanding. Observable interactions (at 20% see **Figure 2**) according to the research participants emerged as

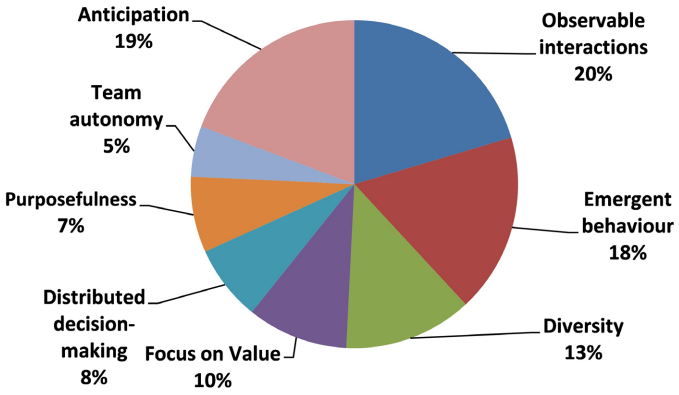

Figure 2. Frequency of the main themes per understanding category as derived from the analyzed empirical studies.

the most mentioned understanding competency that aided the project leaders for exploring the project environment. Managing project complexity learning is a change in observable behavior that results from many years of project experience.

Most of the project managers described how systems environments are constantly changing through the course of the project, which are sometimes orderly and, at other times, disorderly. According to project leaders, in different ways, they must interact with multiple actors and are constantly dealing with emergent behaviours such as lack of clarity and consistency in stakeholders needs causing unintended consequences. Participants WTN1, WTN3, WTN5 and WTN20 are the examples where participants expressed how meaningful "understanding" was in their experiences in a supported managerial complexity program.

Participant WTN1 recounted a point that influenced his motivation: *"I made the decision to focus greater attention on the development process rather than on the system that team will eventually produce. This was one step in my attempt to move from requirements-centric instruction to value-centric development instruction."*

Participant WTN3 stated: *"…it takes a lot of listening and a lot of interacting before you can move to that next level where you have a relationship with the team that is two-way… where you can anticipate where a particular team member is going with a thought or idea."*

Participant WTN5 also conveyed that decision-making uncertainty challenges are influenced by the potential of a successful product resulting from a purposefulness and interrelatedness within the development team. He wrote: *"I think focusing greater attention on the views of those internal to the company rather than solely valuing the views of senior consultants who come from outside to consult, evaluate what goes on there and engage in theorizing about it. This shift led to such innovations as qualitative research-with its valuing of the subjective and affective, of the participants' insider views and of the uniqueness of each context."*

Participant WTN20 conveyed an understanding that project managers can anticipate by making three kinds of decisions involving project events or chal-

lenges that have just happened or that the team is facing requiring a what next question scenario; analysis of the event or challenges will enable the project team focus on the potential significance of the project events, focus on the power the specific challenge or event might have to shape the project future events and challenges; and project manager's judgments about project complexity management long-term trends, how events or challenges can exemplify such trends, and what kinds of analogies or comparisons team members see as plausible. He wrote: *"I encourage newly qualified project managers that most projects are really complex, and it is essential to organize their thoughts and assumptions about their current and future projects in a way to see which past and current events they think were most significant and might recur."*

The views of the participant WTN5 shows how important understanding and shaping emergent properties are to the success of the project.

4.3.2. Perception Competencies

The second thematic or competency category that emerged from the data was labelled, *Perception*. The category pertained to the key components of anticipatory thinking which enable the project executives and managers to adapt to the demands of complex systems development process environment. Perception of project complexity is idiosyncratic. A situation could be perceived in different forms, and different situations could seem the same. This ambiguity in the perception of states, like what Crook and Hayes [72] referred to as perceptual aliasing, has serious effects on the ability of most learning algorithms to construct consistent knowledge and stable policies. The *Perception* factors contributing to project complexity are graphically presented in **Figure 3** below, ranked according to the percentage response, as reported by the respondents. Adaptive leadership was reported by 24% of the respondents and in certain cases it was highlighted as the main factor. Following closely at 21% is bottom-up feedback as the most reported factors helping the project leaders/managers to coping with managerial complexity.

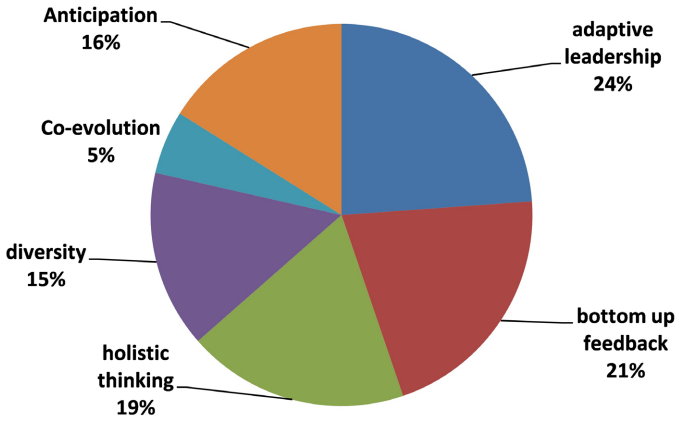

Figure 3. Frequency of the main themes per perception category as derived from the analyzed empirical studies.

For instance, adaptive leadership competence is a content analysis skill. Context analysis skills are necessary for anticipatory thinking involving the gathering, analyzing, and dispensing information for tactical or strategic purposes. Training project complexity leaders to have adaptive leadership skill develop practitioners with the ability to synthesize and embed management theory within their own experience and theories of practice, critically assess and reformulate theories, and apply this information on the fly when appropriate circumstances present themselves.

Participant WTN5's approach recognises the importance of the need for readiness to adapt the leadership style, responsibilities, and bottom-up feedback. Participant WTN5 states: *"…achieving better project leadership through continuous creation of knowledge, skills and experiences gained through continuous professional development and operational experience."*

Participant WTN 1 wrote: *"I would say the global nature of the system development project (for instance the data architectural and modeling teams are based in UK while the interface/dashboard team in India) afforded me the opportunity to remove myself from the main stage and into a position where I can observe the entire system. As the project leader, I try to enable rather than control the project outcome by cultivating conditions where my varying teams can produce the imaged innovations. I do not try to direct change or control future outcomes. Anyway, I don't think I will succeed if I try to."*

Participant WTN 8 argues profound show of lack of proportionality in some of the system requirements and the stated business effects. Participant WTN 9 wrote: *"Team members from designers to developers work side-by-side and have input during each stage of the analysis and construction processes. Most often plans are developed at the lowest levels and are then passed on to each next higher level."*

Participant WTN 4 wrote: *"My overall altitude to system development process has changed and I can probably say that for most of my project team member. You kind of adopt wait and see to the uncertain situations."*

Evaluation of data showed that practitioner WTN 4's statement is classical case of "a system and the environment influencing each other's development to either success or failure (a finding consistent with Kaufmann, 1999 remark on co-evolving) [73].

Participant WTN 12 wrote: *"As a team, we planned our project training requirements taking into consideration what we know of the situation to date, our understanding of the changes expected over time is likely to entail, what may happen as a result and finally what we must do as a team to still have a success in our project."*

4.3.3. Action Taken Competencies

The final thematic or competency category that emerged from the data labeled *Action taken*, are the answers to question "*What do project leaders do in response to the complexities they have identified?*". The category pertained to the key components of anticipation thinking which describe the approach the project managers

took to solving complex problems. Simple rules, holistic thinking, team coordination and establishing a well-informed governance team, emerged as the most cited approaches undertaken by the project leaders/managers to attacking the challenges of the managerial complexity. Project manager's ability in changing behavior or behavioral biases and predispositions of the team members and stakeholders is a fundamental competence necessary for successes in the project. Changed mindset is extremely important as indicated by a good number of the participants. To them, the emphasis should be on a specific ability to plan for the project requirements, focuses on the impact of expectation of current behavior and look ahead steering the team to a successful conclusion. Figure 4 below contains selected core themes (competencies) that emerged from this thematic category. Accumulations of lessons learned (15%), enacting of simple rules (15%) and interoperability (15%) competencies were judged to be extremely important.

Below is sample extract from the study participant's responses. They are not the exclusive responses to the action taken, but this is the set of responses that have the most natural fit with this set of complexity management anticipatory thinking stage.

Participant WTN 18 *emphasised the need to create stable, invisible, assumed relationships between project team and project challenges, enabling common practices and outcomes. When every member of the team can see and understand the big picture, it is easier to understand how each person's work fits in with the other parts of the project.*

Participant WTN 1 for instance stated that: *"With agreed rules in place, increasingly I have learned to drop principles of line-of-sight management instead trusting my team to do their work and focus more on the overall results. Guidelines are our tools of work, but we have learned to rather allow for meaning to emerge in continuous interaction of the team. Wherever there is a conflict between members of my team, I have always favoured an approach that seeks to build relationships with both of those people as a first resolving process. We have n greed formal process for such an issue where relationship building did not succeed*".

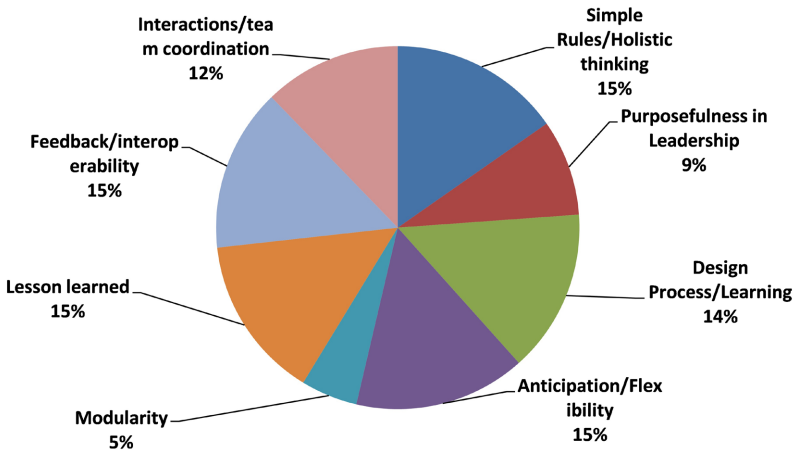

Figure 4. Frequency of response on action taken category as derived from the analyzed empirical studies.

Part of Participant WTN 2 responses and action taken: *"The inconsistencies in the regulatory directives and the internal directorate interpretation of such directives affect the success of the project. It means that timing is everything. Therefore, designing into the development processes the ability to close temporarily and reopen when more information can increase a project's value and can mitigate the problems that are associated with poor timing. I am more convinced now that it is best to seek out problems and solve them before they become tangible."*

Participant WTN 2 stated *"the importance of the need to consider the actions and reactions made by stakeholders as they interact with each other throughout the project".*

Participant 7 wrote: "*Facilitating the understanding the nature of complexities in the project at the initiation or in the middle is an important capacity to have. The result is that the team will have a common vocabulary to speak about these things and a collection of examples to point to. New challenges are common in our work. So, when a new situation comes up or a new causal relation needs to be discussed, the team can relate them to the examples used in the exercise. Through their interactions with a changing environment, such project team demonstrate resilience".*

Participant WTN 9 wrote: *"People can and will process information, as well as react to changes in information… The team are becoming more responsive to the project rules which we have all agreed to. What we did was basically to digest the overall project guidelines in a simple format. This became the team decisions guide ensuring good coordination and reflection. I can see in the team a development of attitude to both think and act according to how the project challenges makes sense to us. Expectation of current behavior actions is not only about expecting a future event but also about changing behavior according to this expectation."*

Participant WTN 10 wrote: *"We follow a process that manages the co-evolution between problem formulation and solution generation. Our project management team is integrated with the design team; the result is that it enables easier understanding of the problems when they occur and to be able to offer potential solutions quicker."*

Participant WTN 16 wrote: *"Project leaders must follow the path of purposefulness in their leadership. Demonstration of honesty, enthusiasm and dedication are all crucial if the project is to succeed. Every team member must live according to* the project *purpose and hold each other accountable."*

Participant WTN 17 wrote: *"I have learned to adopt a design approach through a process of diverging to explore possibilities, and converging to the ones that meet the needs of the project stakeholders and the project requirements."*

Project manager Participant WTN 2 contributions of the importance of considering the actions and reactions made by various stakeholders as they interact with each other reflect the findings in Eden and Ackermann, and Lehtinen *et al.*

[74] [75]. The necessary component of leading on purpose is the vulnerability that the leader embeds in their leadership by asking for feedback. According to Participant WTN 3 coordination has brought better results than controlling as a leadership paradigm. A person having ability to process information, as well as react to changes in information as stated by Participant WTN 9 is a needed competency; ability to think deeply about systems in their context or environment. Participant WTN 7 talks about team through their interactions with a changing environment, demonstrating resilience. This is a great way to fill the gap between project management knowledge and the realities of practice. It means that the project team acquired the capacity to adapt and survive (consistent with the findings of [76]). Evaluation of data indicates that practitioners possibly employ relational means rather than formal processes to respond to certain complexities. For instance, Participant WTN 1 wrote "*I have always favoured an approach that seeks to build relationships with both of those people as a first resolving process*." This is a finding consistent with the findings noted in Park and Lee [77]. The point of practicing design approach stated by participant WTN17 is a demonstration of anticipation thinking in expressing his experience. The Participant WTN 16 statements that *"Project leaders must follow the path of purposefulness in their leadership; demonstration of honesty, enthusiasm and dedication are all crucial if the project is to succeed; and that every team member must live according to* the project *purpose and hold each other accountable" are example of* an ability to prepare to deal with future challenges in the form of either problems or opportunities defined as anticipatory thinking by Mclennan *et al.* [44].

5. Conclusion

Interpreting the meaning of experience in project leader's everyday contexts under the *Understanding, Perception and Action Taken* analytical layers have contributed to and shaped the knowledge base surrounding complex cognitive skills and their acquisition. To accomplish this, practitioners must possess very diverse skills. Based on a phenomenological study, elements of the key competencies required of the project leader for managerial complexity success were identified and classified. The discussed complexity anticipatory model is not a rationalistic approach. The results encourage and embrace uniqueness of people-project leaders and their rich, expressive, and embodied skills that are attuned to the open and dynamic character of context. This is not unusual. In a theoretical paper, Tsoukas [78] warns against the temptation to produce a simplified and abstracted version of the challenge and instead seeks to build a rich picture of the case in all its complexity by drawing together different kinds of data from multiple sources using a technique he calls conjunctive theorizing. On the assessment of complexity, Williams *et al.* [79] argue that as complexity increases, it becomes harder to assess objectively what constitutes that complexity, and "gut feeling" becomes increasingly important. Complexity contributes to project failure in organizations. Improving the efficiency of sustainable practices thereby reducing

the impact of complexity involved is one action taken factor identified. Achieving sustainable project management requires strict adherence to various principles and the integration of long-term and short-term goals. El Khatib *et al.* [80]. It is important to note that the study participants were, mostly, very experienced in their work, thus, it is right to argue strongly that the kind of anticipatory thinking substantiated by our study participants is a product of their accumulated domain-specific declarative and procedural knowledge of managing complex projects. Our findings demonstrate that this study's *Understanding, Perception and Action Taken* framework is an anticipatory innovation. Using the *Understanding, Perception and Action Taken* approach to describe project complexity understanding could enable a better fit with the person being chosen for the project leadership role. The first limitation of this study was the possibility for social desirability bias as the study was conducted using interviews, while program executives, program directors and project managers were working in their offices. Moreover, the response of the participants might be inflated or underestimated due to individuals with some interests. Some work is still to be done. First, the *Understanding, Perception and Action Taken* framework needs to be computed and tested to be finally validated. The various anticipatory behaviours associated with *Action Taken* phase should be fascinating to explore.

Conflicts of Interest

The authors declare no conflicts of interest.

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