

A Case Study of Applying Complexity Leadership Theory in Thales UK

Dawn Gilbert, Laura Shrieves, Mike Yearworth

Abstract Organisations with core capabilities in systems engineering solution development often fail to meet delivery expectations in terms of cost and timeframe. This outcome is viewed as an emergent property of the development organisation, which can be considered a Complex Adaptive System (CAS). The context needed to support complex technical innovation within the organisational CAS appears to be in conflict with a hierarchical bureaucracy in development organisations, whose methods and approaches are best suited to simple and complicated contexts. The paper identifies Complexity Leadership Theory (CLT) as a framework that may offer a way forward in this space. The paper describes two industry-based case studies that sought to practically apply CLT, and provides insights that may be useful to other industrialists interested in applying CLT within their contexts.

1 Introduction

The frequent and high profile failing of systems engineering solutions to be delivered to meet cost and schedule expectations has motivated and shaped a systems research program in Thales UK (Gilbert et al, 2014). Thales UK, like many other businesses with a core practice in development of complex technical systems, has sometimes struggled to meet these delivery expectations. If the organisation is viewed as a CAS (Cilliers, 1998), with solution delivery as an emergent property, then interventions that attempt to narrow the gap between expectations and delivery must align with a paradigm that appreciates complexity. Interventions in this type of system with this goal in mind can be viewed as an engagement with a wicked problem (Rittel & Webber, 1973). Engaging with a

Dawn Gilbert
University of Bristol Industrial Doctorate Centre in Systems,
Merchant Venturers Building, Woodland Road, Bristol, BS8 1UB. UK
Dawn.Gilbert@bristol.ac.uk

Laura Shrieves
Thales UK,
Manor Royal, Crawley, West Sussex, RH10 9HA. UK
Laura.Shrieves@uk.thalesgroup.com

Mike Yearworth
University of Bristol,
Faculty of Engineering, Queens Building, University Walk, Bristol, BS8 1TR. UK
Mike.Yearworth@bristol.ac.uk

wicked problem implies the problems are essentially unique, intervention is a one-shot operation since it is impossible to conduct controlled experiments, solutions are viewed on a spectrum from good to bad rather than purely in terms of success or failure, there is no immediate and ultimate test of a solution, and there is no stopping rule (Rittel & Webber, 1973). A case study of an intervention in a wicked and messy problem, therefore, does not produce outcomes that could be thought of as generalisable, since the context and problem are unique. However, the methodology used to intervene in the problem situation can be viewed as generalisable (Yearworth & White, 2014). Therefore, this case study presents research that explores whether something that is possible in theory – the intentional application of Complexity Leadership Theory (interpreted here as methodology) - is also possible in practice.

The overarching Systems Action Research Program within Thales UK engages with this wicked problem, aiming to enhance the ability of its systems engineering function to support solution delivery that meets or exceeds customer expectations. The case study described in this paper was carried out within the Thales UK Systems Engineering Function. Projects within Thales UK are delivered through the transverse and dominant project-led organisational structure (Hobday, 2000). The form of function and project reporting lines are that of a hierarchical bureaucracy. The project-line dominates, and is reductionist in its approaches and methods which suit simple and complicated contexts only (Snowden & Boone, 2007).

Systems research within Thales UK has previously identified misalignment of methods and problem context as potential contributing factor to poor delivery performance (Gilbert et al, 2014). This issue is not unique to the systems engineering activities within Thales UK. Research by Cowper et al (2014) was based on data gathered in survey responses from 85 systems engineering project professionals. That data set showed that approaches used do not suit the context of the problem, behavior is driven by a narrow view of what an organisation believes is right rather than the broader range of practices they allow, and that project professionals adopt preferred approaches which they which they apply across more than one different type of problem and context (*ibid*).

1.1 The Problem Situation

The problem situation addressed by this research lies in situations where systems engineering organisations, through mandate or through culture, support the use of approaches (simple or complicated) that do not match the context needed to support productive and innovative systems engineering work (complex), and that systems engineers are not able to specifically identify this misalignment within their practice as part of their decision-making process.

This problem situation resides within the CAS that is the development organisation and an emergent property arising from this problem situation is the gap between what is expected and what is realized in terms of delivery cost and timeframe.

A Possible Way Forward. If the organisation is viewed as a CAS and the agents operating within it are currently limited in their ability to identify the nature of their working context, its dynamics as well as which methods and approaches support productive progress, then perhaps an intervention that improves these capabilities may support a transition towards more desirable emergent properties of the CAS itself. Complexity Leadership Theory (CLT) (Uhl-Bien, et al., 2007) was identified as a conceptual framework that may offer a way forward within this problem space, and may be of interest to similar systems engineering organisations.

2 Complexity Leadership Theory

The CLT is a framework with dynamics (Uhl-Bien et al., 2007). “At its most basic level, Complexity Leadership Theory (CLT) is about leadership *in* and *of* complex adaptive systems” (Uhl-Bien & Marion, 2009, p.631). “This framework describes how to enable the learning, creative, and adaptive capacity of complex adaptive systems (CAS)” (Uhl-Bien, et al., 2007, p300). “This conceptual Framework includes three entangled relationship roles (i.e. adaptive leadership, administrative leadership, and enabling leadership) that reflect a dynamic relationship between the bureaucratic, administrative functions of the organization and the emergent, informal dynamics of complex adaptive systems (CAS)” (Uhl-Bien et al., 2007, p298)

“Complexity Leadership Theory seeks to foster CAS dynamics while at the same time enabling control structures for coordinating formal organizations and producing outcomes appropriate to the vision and mission of the organization” (Uhl-Bien et al. 2007, p300). In 2009, the theory was considered in the context of bureaucratic forms of organising to generate emergence and change in organisations (Uhl-Bien & Marion, 2009).

“The unit of analysis for Complexity Leadership Theory is the CAS. The Boundaries of CAS are variously defined depending on the intent of the researcher, but however identified, they are, without exception, open systems” (Uhl-Bien et al., 2007, p 302).

2.1 *Applying Complexity Leadership Research*

Brown identifies two strands of complexity leadership research: “There appear to be two general types of research on the behaviors required to engage in complexity leadership. In the first case, some researchers...have identified the principles of complexity sciences and then extrapolated leadership behaviors from them. The second variation consists of researchers...who have longitudinally studied (sometimes retroactively) organisational and inter-organisational emergence phenomenon, using the lens of complexity leadership theory and begun to validate the behaviors predicted by complexity leadership theory. There has been no longitudinal research done to date that I am aware of in which leaders

intentionally applied complexity leadership theory to their organisation and overall organisational performance was monitored.” (Brown, 2011, p8-9).

The literature search performed in support of this work identified recent examples of empirical research that further developed CLT, (Havermans, 2014), however no literature describing the intentional application of CLT was found. This case study attempts to intentionally apply CLT.

Considering the intentional application of CLT, Brown identifies a potential limitation regarding the degree of meaning-making maturity that may be required to effectively engage with it. “Experts tend to be immersed in the logic of their own craft and regard it as the only valid way of thinking” (Brown, 2011, p18), “the training of it should probably be reserved for leaders who have demonstrated advanced (i.e. post-conventional) meaning-making capacity. It does not seem realistic to expect leaders with a conventional action-logic to learn and sustainably engage with it over an extended duration” (Brown, 2011, p18).

3 Research Design

It is appreciated that the case study organisation is dynamic and there are often great demands on the time of systems engineers, which limits the amount of time and attention they have to apply to discretionary activities. Individual systems engineers, however, often have an appetite for accessible and novel concepts that may give them a clearer or deeper understanding of their context, the problem at hand, or methods to help progress work. Appreciating the balance of these pressures, opportunities were sought to introduce CLT concepts to stakeholders within the organisation and to offer resources to support those who wished to learn more or put the theory in to practice. Positive uptake is seen as an indication that the theory is initially viewed as promising, however, a lack of uptake within this context is not indicative of the theory being considered impenetrable, irrelevant, unusable or lacking in value.

A case study approach was taken by introducing CLT as expressed by Uhl-Bien & Marion (2009) in successive levels of detail to stakeholders within the Thales UK Systems Engineering function. Where initial interest was expressed, further information and research support was provided. This is consistent with an action research based approach of engagement with a wicked problem. This approach was selected with an awareness of the points made by Brown (2011); the meaning-making maturity of the Thales UK stakeholders was unknown, as was the level of meaning-making maturity that would be needed.

3.1 Case Study 1

Initiation. The concepts of CLT were initially introduced via an email conversation to the Key Stakeholder in Case Study 1 as a theory considered relevant to an industrial problem that had been explored in an unstructured discussion the week before. This industrial problem related to the apparently

conflicting needs of a large organisation which develops large complex technical solutions to control its business through extensive application of reductionist and prescriptive processes, yet also provide the intellectual latitude and freedom needed to develop technical innovations. The email contextualized research relating to complexity in systems engineering development lifecycles, new product development, leadership, business, and management by Akgun et al (2013), Braha & Bar-Yam (2007), Hazy & Uhl-Bien (2013), Houglum (2012), IBM (2010), Lichtenstein & Plowman (2009), Nugent & Collar (2014), Shreiber & Carley (2006), Uhl-Bien et al (2007), Uhl-Bien & Marion (2009), and Van Oorschot et al (2010) to the problem as it was understood at the time.

The Case Study 1 Key Stakeholder was the Thales UK Head of Systems Engineering. In CLT parlance, a role that traditionally was expected to lead by carrying out and overseeing administrative leadership tasks, while also is responsible for successful development and delivery of technical innovations across the organisation. The concepts of CLT described in the initial email underpinned a further one-to-one discussion, which elaborated on the concepts within CLT and how it related to the organisational context at the time.

Method. Consideration of CLT within the problem context led to the Key Stakeholder taking an ‘extraordinary’ step of purposefully enabling a group of 20 Systems Engineering architects, from across a diverse range of Thales UK Domains and Business Lines, to gather together for a week-long workshop to explore and possibly develop a common core architecture for use across all Thales UK business lines. This step was ‘extraordinary’ within the organisational context at the time, its uniqueness illustrates that the approach was a purposeful application of a novel theory, and not a continuation of business as usual. The Key Stakeholder was able to apply influence to enable presence and participation from a group of Systems Engineers who would normally be under immense pressure to stay ‘on project’.

The workshop was held in a design center that supports but doesn’t prescribe the use of design-thinking concepts. The normal prescriptive and detailed processes that the architects would generally work within were “banned from the room” (Key Stakeholder, workshop day 1). On Monday morning, at the start of the workshop, the Key Stakeholder provided a brief introduction to participants that described the broad remit and aims for the week, and allowed, in fact encouraged the participants to self-organise. “run it fairly loose, control and process is minimal...we've got tools here, uncontrolled space....use your imagination...have fun, enjoy...you are all intelligent people...its self-organising in the extreme” (Key Stakeholder, workshop day 1).

The Key Stakeholder and workshop participants were aware that the work they were doing was part of ongoing Thales UK systems research. The workshop was video recorded, portions were audio-recorded, several photographs were taken, and field notes were taken by the action-research participant / observer. Participants were invited to submit free-form email feedback on how they had found the experience.

Data. The data collected as part of this case study is comprised of: meeting notes; emails; notes taken during phone conversations with the Key Stakeholder in

advance of the workshop; video recordings; photographs; audio recordings; field notes gathered during the workshop; and, email-based feedback provided by participants after the workshop.

Selected comments from email feedback include:

- “The approach to the workshop removed normal project/organisational constraints thus enabling the team to realize their potential”
- “In just four days of Design Centre enabled, Cross Domain, Cross Discipline Co-Architecting activities we have achieved what had previously taken (in my experience at least three times now) at least a year if not more. Co-engineering activities have been delivering some successes across the UK now for a couple of years but this activity has in my “humble” opinion pinnacled them all.”
- “We all have our own mental models of [the core architecture] and much of that is shaped by past experience but despite that we were all able to think outside the box and that is fundamental to the success of the event...we made more progress over 4 days than we had in the previous two years with the one day workshops we ran”
- “When I first entered the Design Centre, I was taken back by its informal nature – but having experienced it I must say it works....Where we got in the four days (and a half) was quite an achievement...overall and excellent experience.”
- “I have not seen any initiative in Thales that has been as dynamic, constructive and productive or achieve the level of cooperation and cohesion within a team that covered many disciplines and business lines”
- “Outstanding opportunity taken to get the right people in the right place for long enough to make real forward progress on a critical transverse topic that can enable business effectiveness in the long term...there is a key action to determine and sell the value proposition for not only the [core architecture] approach, but also the process of collaborative exploration that we have followed this week”

3.2 Case Study 2

Initiation. The concepts of CLT were initially introduced to one of the case study 2 stakeholders by copying them on an email to a different audience, that focused on a different topic, but which referenced and included Uhl-Bien et al (2007) as one of many attachments. This introduction to CLT suggested, to the stakeholder, that CLT might hold some promise towards addressing an issue they had recently discussed with another case study 2 stakeholder. Further discussion between these two Key Stakeholders led to a request for broader and deeper engagement by the research team.

Method. A group of systems engineers based on the same site as the two Key Stakeholders were invited to a 90 minute briefing session on CLT. Those who couldn't make the originally scheduled session were invited to participate in a second session, which was held around 10 days later.

The term ‘systems engineer’ in Thales UK covers a broad spectrum of role types, as may be expected from an organisation spanning diverse operating domains and solution types. Similarly, depending on the programme, systems

engineers may varying levels of involvement with customers, project managers, systems engineering peers, engineers within other specialisms, subcontractors, and colleagues specializing in areas such as quality or purchasing.

As participants entered the CLT briefing session they were advised that the session was being used for research purposes and that, as such, the discussion was being audio recorded. They were asked to complete a single-sided A4 hard copy 'before' survey which was gathered back in before the briefing commenced. This survey was designed to ask non-leading questions to establish the potential relevance of the CLT concepts for the role each participant performs as well as to gather initial views on their appreciation of and perceptions relating to socio-technical complexity. A briefing was then given which briefly described the Cynefin Framework (Snowden & Boone, 2007), then built on that description to introduce CLT. The Cynefin Framework was introduced initially as a basis to provide a tangible definition of complexity, and to introduce how different contexts suit different approaches to progress. It has been described to other audiences within Thales UK's Systems Engineering Function before, and found to be a description of complexity that can be appreciated quickly. The briefing also mentioned that the UK Head of Systems Engineering had put CLT in to practice successfully. After the briefing, a second single-side A4 hard copy survey was handed out which asked participants to rate on likert scales the prevalence of contexts (as described in Snowden & Boone, 2007) in their work environment, and their use of CLT behaviors (as described in Uhl-Bien & Marion, 2009).

The participants were then invited as a group to discuss their initial views of the frameworks and to discuss whether they thought these related to their own work. Before departing participants were invited to note on the back of their 'after' surveys 2 or 3 opportunities that would occur within their normal work in the upcoming month where they could consider the frameworks in advance of, during and after the work. Participants were advised that after the opportunities occurred they would be briefly interviewed by the research team (in person or by phone, depending on what was most convenient) to gather their views on how relevant the frameworks were 'in real time' and to see whether reflecting on their initial introduction to these frameworks was able to support their everyday decision-making. Participants were advised that this would likely take 10-15 minutes.

The annotated 'after' surveys (which could be linked to an individuals 'before' survey) were collected, converted to an anonymized soft copy, and emailed back to each participant, thanking them for participating, giving them initial feedback on how their surveys responses may be interpreted, and suggesting a time and method for gathering reflections on the attempted application of theory.

In all, 16 participants took part in the two briefing sessions and completed the surveys (see Tables 1 and 2 for a summary), 14 participants agreed to consider the frameworks in their work. Three participants couldn't be reached for feedback on their practical application; however feedback was gathered from the remaining 11 participants by a one-to-one in-person or telephone-based semi-structured interview. The semi-structured interviews used a tone and vernacular that mirrored the participant. Questions explored how participants understood the frameworks and how they related them to their environment, and their own behavior and the behavior of their colleagues. The author carried out all the

interviews over the course of 2.5 weeks to ensure consistency. One of the interview summaries was provided back to the interviewee for comments to confirm whether this note-taking approach was able to accurately capture content and intent of the discussions. The interviewee stated no editing was required.

Data. The dataset for this case study, therefore, includes the email exchanges and notes from phone calls which led to the briefings being held, the before and after surveys, the presentation materials and audio recordings of the briefings and follow-up free form discussion, one-to-one email exchanges regarding interpretation of the surveys and opportunities to apply the frameworks, and the interview notes which were promptly written up electronically based on hand-written notes made during the interviews.

Table 1 Summary of Selected ‘After’ Survey Responses

How often do you observe these contexts in your work?					
<i>Context</i>	<i>Never</i>	<i>Rarely</i>	<i>Sometimes</i>	<i>Often</i>	<i>Always</i>
Simple	0	1	4	6	5
Complicated	0	0	5	11	0
Complex	0	1	8	7	0
Chaotic	0	7	7	2	0
How often do you engage in these leadership behaviors?					
<i>Behavior</i>	<i>Never</i>	<i>Rarely</i>	<i>Sometimes</i>	<i>Often</i>	<i>Always</i>
Administrative	0	3	1	12	0
Enabling	1	1	10	4	0
Adaptive	2	2	8	4	0

Selected quotes from the follow-up interviews include:

- Participant 1: “I do a different job, front-end, dealing with sales and marketing...from an engineering perspective....it’s a mature, repetitive process”
- Participant 2: “I think in my case you have your own style which is the way you manage projects. If you start thinking of contexts, then you can select methods that work and if you think about it and select the right methods, that becomes your new style...Another thing that might be interesting to explore – this is targeting engineering, but things like QA [Quality Assurance] and purchasing perhaps could do with more CLT work with these functions...We need more experience in admin, enabling, adaptive. We need a bit more time to recognize and learn how to act”
- Participant 3: “It was definitely in chaos...it was a rollercoaster...trying to follow the ideas you presented was very difficult...there were occasions where in particular I could see contexts...but you have limited influence, not none, you can always do something...list the assumptions you used...Others were making decisions...That said, I’ve never seen anything quite this bad...In response to the question you asked which was did it have any use, I’d have to say ‘limited’...I would recognize areas of the business where the bureaucracy is more restrictive than it needs to be to provide support for engineers or anyone to use their initiative or take responsibility to come up with their own ideas, I can see that, but it’s not black and white....if its right for the present, is it right for the future? That becomes a difficult way of looking at it, whoever looks at it has their bias”

- Participant 4: “What you were saying...I can relate to it, being adaptive...it was really good to listen to you, it makes perfect sense, it was good to be on a project that is practicing the approach...In a different team there are different ways...about 2 years ago, I wouldn't necessarily be able to say that it would have been relevant, but for me at least the timing of your lecture was perfect”
- Participant 5: “I can clearly see it [CLT] applied to the business we are in... I certainly had no problem understanding how it related...the problem I've got is in doing something...I'd say that's the enabling part – money and support. People and commitment are lacking, they say 'that's a good idea get on with it', but then you can't”
- Participant 8: “We've just been too pushed so far...I haven't looked at the frameworks”
- Participant 10: “I want a single page that tells you what to do to do your job”
- Participant 12: “Throughout the [first] meeting I was aware of the different sorts of leadership behaviors and I could adjust. I was more aware of the styles, but I'm not sure whether it changed what I did. I probably would have done the same thing, but maybe the clarity helped me to do it earlier.....The [second] meeting itself wasn't productive, but afterwards S and I spent about 2 hours on chairs in the open area discussing how to get value out of the group, and it was amazing...It was a weird one, in the meeting I'd wanted to do enabling, but they don't understand the problem enough, so I had to do administrative behaviors. With S we were adaptive in how we came up with ideas about what to do, it was great...If S and I hadn't got so disenchanted with how the meeting went I'm not sure the later one [in the open area] would have happened.”
- Participant 14: I find myself flitting about the three behaviors, administrative, adaptive, enabling all the time...the framework keeps you sane, you need something to help you navigate when you have to flit around...I don't feel constrained by the SEM [Systems Engineering Manager] role, I look at the processes as providing a good guideline of what is needed, what needs to be established for quality etc., but it doesn't tell you how to work, that's up to you. I mean your frameworks...I recognized it all...in summary I think the frameworks don't tell you how to do things, you can say here's things I recognize, here are some pointers on what to do”
- Participant 15: “I definitely recognize them [the three CLT behaviors], I don't get to do anything with them though, we are so busy....There is a preference to serve issues that are short-term....we plan so many programs as if they are simple, and on almost every program there's something that gives us a problem, that's not deterministic...If there's a big problem of course the first question asked is how long will it take to fix and how much will it cost, but the people solving it don't know, then it becomes a bit chaotic, you have to do the work to find out, it takes as long as it takes, people are always pushing specific plans and timeframes...its more the PM [Project Management] world, and I can understand where they are coming from, they don't like unknowns...For PMs the more we can make them understand the problem the better, it doesn't feel like they do. If you get them in a room and they understand it, they'd struggle to recognize it when they faced it in their work the next day”

4 Analysis

The data collected during the course of the two interventions was reviewed with the aim of answering the compounding questions of whether CLT is understandable to practicing systems engineers? Are the components and dynamics described by CLT recognizable in the environments those systems engineers work in? Is it possible to apply CLT within the Thales UK systems engineering context? Can applying CLT within the Thales UK systems engineering context be valuable?

The evidence from these case studies supports the view that CLT can be understood by practicing systems engineers. The Key Stakeholder in Case Study 1 was able to take specific actions on the basis of appreciating the theory and how it relates to the problem context. The survey responses in Case Study 2, presented in Table 1 suggest that respondents could both understand and relate CLT behaviors (as well as the Cynefin Framework) to their work environment and actions. The ability of the Case Study 1 Key Stakeholder to deliver the core architecture workshop demonstrates that CLT can be applied within the Thales UK systems engineering context, as do the comments provided by Case Study 2 Participant 12. The feedback comments from Case Study 1 workshop attendees demonstrates that the application of CLT which led to the workshop being held, and guided how it was run supported achievements made during the workshop that are considered valuable within Thales, and unachievable using 'normal' approaches. Case Study 2 Participant 12 wasn't sure whether the application of CLT led to better decisions and actions, although they note that they may have made their decision more quickly, which supports the notion that the further application of CLT within Thales UK could provide value. Case Study 2, Participant 14, reported that they use each of the CLT behaviors and whilst knowledge of the theory itself may not change what they do, familiarity with the framework provides a valuable structure from which to navigate from.

5 Discussion

The case studies performed within Thales UK demonstrate that CLT can be intentionally applied, as demonstrated in this systems engineering context. It's application can support the achievement of desirable outcomes more quickly and with greater confidence. The data collected also suggests that outcomes that could not be achieved within 'normal' operating conditions may be possible via the intentional application of CLT.

Brown (2011) proposes that leaders with more mature meaning-making systems may be more capable of engaging with practices of complexity leadership. Conversely those with conventional meaning-making systems may not be able to fully adapt to the fundamental changes in leadership perspectives called for by complexity leadership. The analysis of the two case studies reported here show there was variety in the need and inclination of participants to recognize the elements and dynamics of CLT within their own context. Participants 1 and 10 of Case Study 2 gave the three responses stating that they never used enabling or

adaptive leadership behaviors. Given the description participant 1 gave of their role, there is no indication that this contributes to undesirable emergent properties of the CAS, however viewing feedback from participant 10 in the round, they appear to have struggled to appreciate the relevance of these concepts to their role and environment. It could be the case that, as a population, systems engineers are predisposed to better recognize how CLT relates to their work, since complexity is a core feature of much of their work. Participants 2 and 15 noted that other Thales UK functions could benefit from understanding CLT, though Brown's view is supported by Participant 15, in claiming that the Project Management community would struggle to apply the theory in practice.

A variety of comments related to time. Participants 8 and 15 indicated they were too busy to consider or use the frameworks. Under the pressure of limited time, participants 3 and 15 identified the apparent tension between interests in pursuing short-term and longer-term value. Participant 4 had, within the last year, transitioned in to a new business line after more than 20 years in a different Thales UK business line. They clearly identified CLT in their actions transitioning in to and leading the systems engineering in a new technical area and found the concepts valuable, although they noted that prior to the move in to a new work environment the theory may not have seemed relevant. Brown (2011) identifies that managers may not be able to sustainably engage in complexity leadership without regular support, however, participant 2 states that in their case, improved abilities to understand context and act appropriately becomes embedded in normal practice.

6 Conclusion

This research has provided an example of how CLT can be introduced to agents within a CAS as a means to intervene in a wicked problem. A variety of short-run responses were observed and are included in this paper, which range from immediate comprehension leading to an application which realized high-value outcomes in the short-term (case study 1), to an apparent inability to see how CLT applied to the working environment (case study 2, Participant 10). These results demonstrate that it is possible to intentionally apply CLT in practice. Longer-term impacts from these interventions continue to be felt within Thales UK, as would be expected from an intervention in a wicked problem.

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