

Towards Practice and Principle Adoption through Continuous DevOps Leadership

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Abstract: The contribution emphasizes research undertaken in highly structured software-intensive organisations and the transitional challenges associated to agile, lean and DevOps practices and principles adoption journeys. The approach undertaken to gain insights to research questions resulted in data collected, through a series of interviews, by thirty practitioners from EMEA region (Czech Republic, Estonia, Italy, Georgia, Greece, The Netherlands, Saudi Arabia, South Africa, UAE, UK) working in nine different industry domains. A set of agile, lean and DevOps practices and principles that organisations are choosing to include in their adoption journeys towards DevOps-oriented structures is identified. The most frequently adopted practices of structured service management that can contribute to the success of DevOps practices adoption are also identified. Results indicate that software product development and operations roles in DevOps-oriented organisations can benefit from specific leadership styles.

Key words: DevOps adoption, software development, leadership, interview.

1. Introduction

In today's lightning-fast technology world, software is starting to play a much larger role in how companies compete across a broad range of industries. As the basis of competition shifts to software, large traditional organisations are finding that their current approaches to managing software are limiting their ability to respond as quickly as the business and the market transformation pace requires.

1.1. Agile, Lean and DevOps Challenges

Structured IT service management frameworks such as ITIL® [1], and project management frameworks such as PRINCE2® [2] and PMBOK® [3] have been introducing numerous decision making roles and gates in IT organisations and thus have allowed more delays in the product development lifecycle. In addition, accountability in structured approaches has allowed culpability in ownership of an incident that has to be resolved, a change that has to be approved, a release that has to be deployed in a production environment. Furthermore, structured approaches to change, release and deployment management of new products and services within the IT industry has led to the innate proclivity of blameful post implementation reviews or post-project delivery lessons learned meetings.

Agile, lean and DevOps principles and practices aim to identify the value adding activities in the IT service management processes and more specifically the product development lifecycle of an organisation and eliminate any type of waste. Therefore, there is clearly a major industrial need to extend, if not shift, from structured service management practices to agility and leanness. The transition from a framework or

process-led organisational environment to the adoption of groups of best practices, entails a significant shift in mindset. There needs to be a clear organisation-specific roadmap on the types of practices and principles that need to be adopted including any team structure that should apply along with any leadership styles that would serve as the adoption guiding compass.

Firstly, the intention of this research is to identify the practices and principles that Agile, lean and DevOps communities have developed, in regard to product development and its overlap with IT service management processes. Secondly, it is also important to realise the effect this can have on structured service management processes. Finally, as a consequence, it is important to identify whether Agile, Lean and DevOps practice and principle adoption requires any sort of leadership and whether that forms part of an individual leader role or team structure.

1.2. Research Questions

The research questions that follow below embody the concerns of this contribution. The first question focuses on the benefits that can be uncovered during an adoption process of new practices and principles from an already established structured approach, in terms of service management, to agile and lean structures within software intensive organisations.

R1) Which agile, lean and DevOps practices and principles can improve productivity in a business environment that has adopted a structured service management approach?

The second research question attempts to identify the specific practices of structured service management that can contribute to the success of DevOps practices adoption and product value maximization.

R2) Can DevOps-oriented environments benefit from structured service management practices?

The third research question aims to uncover the importance of whether leadership is required in the DevOps practice and principle adoption journey including any special characteristics.

R3) Can Leadership affect DevOps adoption within an organisation and to which extent?

2. Defining Agile, Lean and DevOps

The Fourth Industrial Revolution is transforming the world of work. Technology is advancing faster than humans, disrupting both jobs and the skills needed to compete. Research by McKinsey [4] suggests that globally about half of the jobs performed by humans today will be disrupted by automation, and a survey of business leaders by the World Economic Forum [5] suggests that 42% of the core job skills required today are set to change substantially by 2022.

Software is starting to play a much larger role in how companies compete across a broad range of industries. As the basis of competition shifts to software, large traditional organisations are finding that their current approaches to managing software are limiting their ability to respond as quickly as the business requires.

2.1. Agile Software Development

During the 1990s, individuals with a desire to think and act outside the structured approaches in project and product management began their first steps towards formulating the agile community. This community would later acquire its term “Agile” coined in 2001 in the Agile Manifesto [6]. The manifesto set out to establish principles to improve the software development approaches taken up till that moment. Agility aimed at solving a lot of the issues that were created in information intensive organisations by structured approaches. In addition, Agile Software Development (ASD) emerged in 2001 as an evolutionary practice to existing structured approaches. The new practice advocated for iterative short-cycled development increments and continuous integration as opposed to structured engineering stage-gate models [7]. SCRUM

[8] has been used as an agile product development approach, “a framework within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value.” [9] and this has also been the case in software-intensive organisations.

2.2. Lean Mindset

The roots of Lean Enterprise stretch as far as 1908, at a time when Henry Ford’s Ford Motor Company was designing and producing Ford Model T automotive cars. The grandiose Model T mass production plan was successful because it provided inexpensive transportation and a symbol for innovation and modernization for the rising middle class in the US. Henry Ford’s methods, better known as Ford Production System (FPS), however, went well beyond the synergistic and mutually supporting practices and techniques that constitute what we now call lean manufacturing [10]. They included the “soft sciences,” the organisational psychology that makes every employee a partner in the drive for success. After World War II, FPS was transformed by Toyota into two pillars known as Just in Time (JIT) and Jidoka aka autonomation [11], [12]. Additionally, kanban boards, kaizen (continuous improvement), poka-yoke (error-proofing) became part of Toyota Production System (TPS) [11], [12].

When the Japanese began to adopt techniques from the Ford Motor Company during the early twentieth century, they knew exactly what they were getting; proven methods for mass-producing any product or delivering any service cheaply but well. To that extent, the Lean Enterprise is all about eliminating friction [10] and reducing time to deliver products or services to market consumers. In the same sense, ever since the term “Lean” was coined in 1988 by John Krafcik [13] and popularized by James P. Womack [14], Lean IT’s main aim has been to transpose the lean manufacturing types of “waste” namely; 1) partially done work, 2) extra features, 3) relearning, 4) handoffs, 5) task switching, 6) delays, 7) defects [8] and a later addendum, 8) underutilized skillset and identify those in IT organisations with an ultimate aim to eliminate or reduce their impact on product development lead times to market delivery. There are not radical changes from ASD to Lean Software Development (LSD) rather an incremental improvement in which Agile is not abandoned when Lean is adopted [15].

2.3. DevOps and its Adoption

DevOps offers an unprecedented opportunity for organisations to transform their Software Development lifecycle to increase efficiency and meet end-users’ changing expectations. DevOps attempts to redefine the foundations of software development and management recasting the approach to every element [16]. The reformation that DevOps brings with its set of practices extends to the customer experience as well.

There are a number of terms and variety of practices that software practitioners use when defining DevOps [17]-[23]. In effect different definitions to DevOps could lead to unnecessary confusion when it comes to IT organisations adopting a DevOps-oriented mindset. Consequently, the numerous associated acronyms that accompany DevOps, have a significant role to play in the result of indecisiveness or definition diversity. DevSecOps or SecDevOps (Development-Security-Operations), BizDevOps (Business-Development-Operations) and DevNetOps [21], have been, admittedly, part of valid definitions of DevOps within organisations. The majority of the descriptions specify DevOps as a term that is used to emphasize the collaboration between software development and operations. There is both a research challenge and an industrial need for developing a better understanding of the DevOps concept and approach [24]. There is also published research work that downplays the fact of not having consensus over a DevOps definition [21].

However, DevOps is more than just a mindset but rather patterns of DevOps practices [19]. There is evidence that Agile Software Development (ASD) informed by lean principles background forms a prerequisite for successful DevOps adoption [22], [23]. Moreover, the CAMS model originally coined by John

Willis and Damon Edwards [25] and later refined to CALMS by Jez Humble, is one of the widely known approaches in terms of identifying what needs to change in a DevOps adoption journey. CALMS shares similarities with another model that involves a specific set of categories namely: agility, automation, collaborative culture, continuous measurement, quality assurance, resilience, sharing and transparency [26].

2.4. Leadership Styles Relevant to DevOps

There are various leadership styles which should be considered when it comes to DevOps let alone the departure from a highly structured organisation with a waterfall approach attempting to adopt agile, lean and DevOps practices and principles. A non-exhaustive list of those leadership styles is provided [27]:

- Transactional Leadership
- Transformational Leadership
- Servant Leadership Theory

The State of DevOps Report discovered a correlation between transformational leadership and organisational performance [4]. Transformational leadership comprises of four dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration [27]. Transformational leadership theory was first posited by the political scientist James McGregor Burns in 1978. "Transformational leaders promote and motivate their followers by projecting and communicating attractive visions, common goals, and shared values. Idealized influence is the leader's ability to build loyalty and devotion among the team members, assisting them to identify with the leader. Inspirational motivation relates to the ability of the leader to provide a vision to its followers and motivate them to work in that direction. Intellectual stimulation activates the followers to be risk-taking and innovative at work. The last one, individualized consideration, is related to the behavior of the leader to pay attention to the individual needs of the followers" [28].

The State of DevOps Report report conveys that DevOps leaders with a servant leadership mentality inspired better team performance [4]. In fact, Servant Leadership Theory, is a mixture of transformational and transactional styles of leadership. In essence, the leader is serving rather than being served and therefore, creates an environment of trust, collaboration and reciprocal service which ultimately leads higher performance [27].

3. Research Design and Method

Having distinguished between the agile, lean and DevOps practices and principles based on literature review it is essential to see whether there is agreement with industry domain practitioners.

3.1. Interview Structure

Regarding data collection, semi-structured interviews with thirty (30) practitioners of companies from Czech Republic, Estonia, Italy, Georgia, Greece, The Netherlands, Saudi Arabia, South Africa, UAE, UK that contributed to DevOps adoption processes in their companies. Participants were recruited by using two approaches: (1) through direct contact in an IT Service Management or DevOps event in Europe and (2) through general calls for participation posted on professional social networks such as LinkedIn and local IT societies such as IT Service Management Forum (itSMF) and British Computer Society (BCS) – The Chartered Institute for IT. Achieving a heterogeneous perspective and increase in the wealth of information practitioners from a variety of organisations were invited and consulted. Table 1 presents the characteristics of the participants that accepted our invitation. To maintain anonymity, in conformance with the human ethics guidelines, hereafter we will refer to the participants as P1–P30 (first column), see Table 1. At the beginning of each interview the interviewee provided consent to the live audio recording and to

the transcript data being only used in the context of the research without disclosing organisation titles. The company size in Table 1 has been categorized according to the European Union Commission recommendations [29].

The approach to primary data collection, was determined based on the ability of IT professionals of the author's professional network, to participate in the research approach selected. The most relevant research method to realizing the research outcomes sought, were one-to-one semi-structured (part of non-standardized) interviews that would form the basis of the qualitative research interviews.

The scope of this research intended to focus on primarily web recorded phone calls and in case that was not possible then opt for a face-to-face interview. The set of technologies utilized for the purposes of web recorded interviews as well as the interview schedule are Skype for Business, Zoom and Windows Voice Recorder.

Table 1. Interview Participant Profile. PX Means Professional Experience in Years, CN Means Country of Work and CS Means Company Size (Micro - MC < 5, Small < 50, Medium - M < 250, Large > 251)

P#	Job Title	PX	CN	Domain	CS
P1	PMO Director	14	Saudi Arabia	Aviation	L
P2	Principal Consultant, ITSM	13	Italy	IT Consulting Services	L
P3	CIO	26	Greece	Insurance	L
P4	Principal Consultant, ITSM	11	UK	IT Consulting Services	MC
P5	Managing Director, ITSM	32	UK	IT Consulting Services	S
P6	Smart Systems Manager	23	Greece	IT Consulting Services	L
P7	Senior Digital Transformation Technologist & Solution Practice Lead	30	UAE	IT Consulting Services	L
P8	Principal Consultant, ITSM	34	UK	IT Consulting Services	L
P9	Founding Consultant, ITSM	19	UK	IT Consulting Services	S
P10	Managing Director	29	UK	IT Consulting Services	S
P11	Head of Remote Transactions	16	Greece	Banking	L
P12	Consultant	34	Netherlands	IT Consulting Services	M
P13	Deputy CIO	22	Greece	Construction Management	L
P14	Head of Applications	18	Greece	Lottery	L
P15	Principal Consultant, ITSM	21	South Africa	IT Consulting Services	MC
P16	Founding Consultant, ITSM	34	UK	IT Consulting Services	MC
P17	Managing Director, ITSM	19	UK	IT Consulting Services	MC
P18	Managing Director and Lead Consultant	14	UK	IT Consulting Services	MC
P19	IT Operations Manager	13	Greece	Lottery	L
P20	IT Operations Manager	15	UK	Government	M
P21	Founding Consultant, ITSM	34	UK	IT Consulting Services	MC
P22	Assistant General Manager, IT Operations	28	Greece	Banking	L
P23	CDO	13	Estonia	Government	L
P24	CIO	20	Greece	Insurance	L
P25	CIO	27	Greece	Aviation	L
P26	Development Team Lead	11	Greece	Lottery	L
P27	IT Operations Lead	12	Georgia	Government	M
P28	Business Development Director	18	Greece	IT Consulting Services	L
P29	Operations and Innovation Lead, IT Services	11	Czech Republic	Courier Services	L
P30	CIO	28	Greece	Automotive	M

3.2. Data Collection

The interviews were conducted between September 2018 and January 2019 by means of Skype for Business calls. The interviews lasted a minimum of 34 min, a maximum of 67 min, and an average of 50 min. Data collection and analysis was aggregated according to the research questions posed in section 1.2 and were mapped to interview questions, see Table 2. The whole set of questions is available at the following URL in the format of an online survey which was designed for the purposes of this paper only: <https://tinyurl.com/ybxrcujq>

4. Analysis and Evaluation

The semi-structured interview series, see Table 3, consisted of twenty (20) interview questions, referred to Q1-Q20 henceforth, whereby the first three questions aimed to collect data on interviewee demographics i.e. job role, industry domain, working country for segmentation purposes as shown in Tables 2-4.

Table 2. Job Role of Interview Participants (Interviewee Count: 30)

Country	No. of Participants
Greece	11
UK	10
Saudi Arabia	2
Czech Republic	1
Estonia	1
Georgia	1
Italy	1
Netherlands	1
South Africa	1
UAE	1

Table 3. Job Role of Interview Participants (Interviewee Count: 30)

Job Title	No. of Participants
Principal Consultant	9
Managing Director	4
CIO	4
Deputy CIO/Assistant General Manager/CDO	3
IT Operations Manager	3
PMO Director	1
Head of Remote Transactions	1
Smart Systems Manager	1
Head of Applications	1
Development Team Lead	1
Business Development Director	1
Operations and Innovation Lead	1

Table 4. Job Role of Interview Participants (Interviewee Count: 30)

Industry Segmentation	No. of Participants
Consulting Services	14
Aviation	3
Government	3
Lottery	2
Insurance	2
Finance	2
Manufacturing	1
Logistics	1
ISV	1
Automotive	1

Moreover, fifteen (15) of the interview participants were IT consultants and another fifteen (15) were employed at customer organisations characterised as “service provider” according to ITIL® [1], see Fig. 1.

The interview participants indicated the most preferred structured, agile and lean practices, see Fig.2 and corresponding principles, see Fig.3. Considering structured IT service management processes there was an identified set of practices that contributes to value delivered to software development end-user as opposed to IT service management processes that act as impediments to it. In fact, Change Management was mentioned to a great extent compared to the rest of the IT service management processes, see Fig. 4 and Fig. 5. Additionally, Service Portfolio Management and Release and Deployment Management conclude the top three IT service management processes which affect value delivery in software development with Service Level Management being a close fourth.

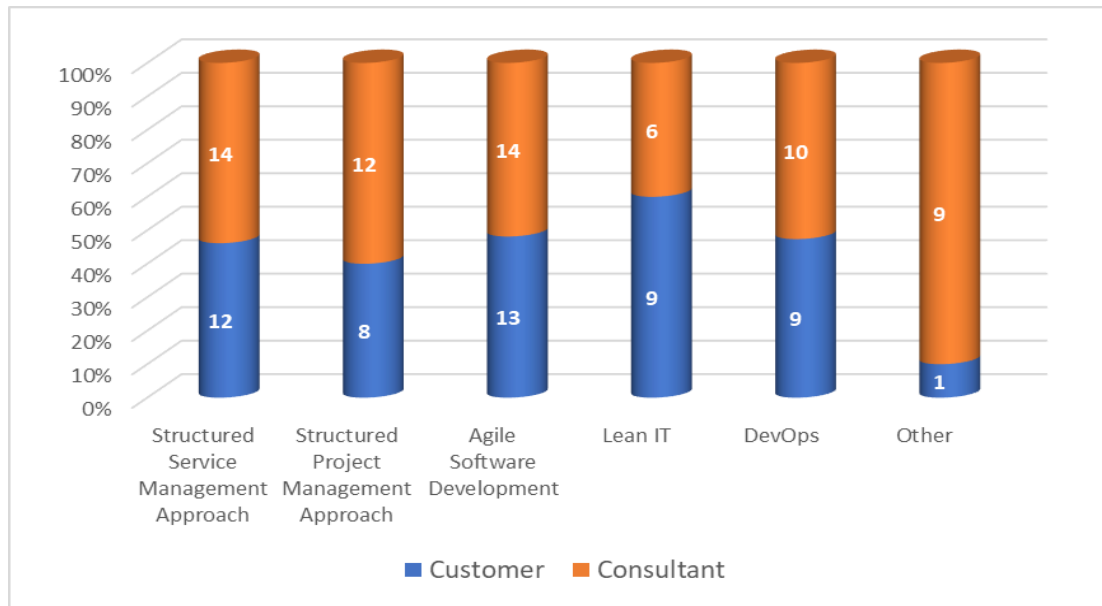


Fig. 1. Customer and consultant experience with structured, agile, lean and DevOps [interviewee count: 30].

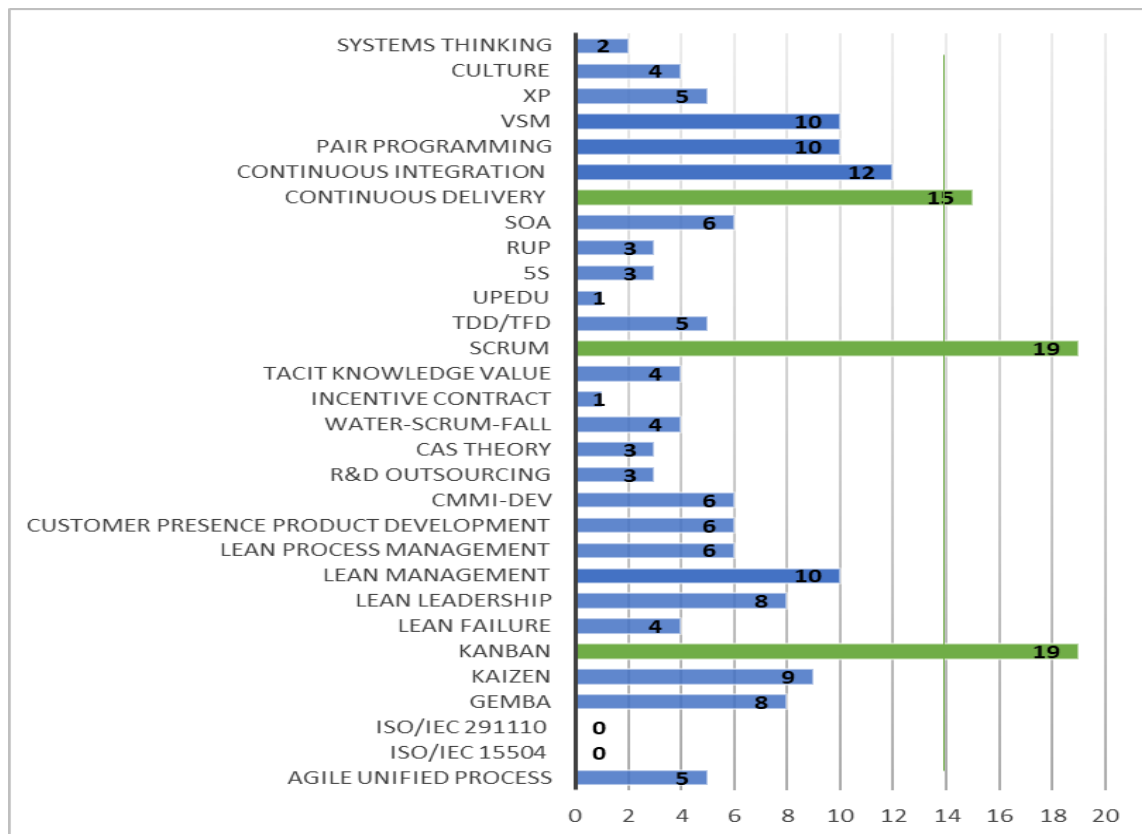


Fig. 2. Agile and lean practices (top 3 highlighted) [interviewee count: 30].

Furthermore, 66.67% of interviewees agrees that agile and lean practices and principles adoption is an extension to already established structured IT service management approaches such as ITIL® and ISO20000 International Standard for IT Service Management. On the contrary, only 20% agrees that a complete replacement of those is required. In fact, the extension of such practices and principles signals the transition an organisation has to pursue in order to achieve the desired adoption level. Moreover, (P3, Greece, CIO) (P8, UK, Principal Consultant) (P23, Estonia, Deputy CIO) (P25, Greece, CIO) (P29, Czech

Republic, Operations and Innovation Lead) and (P30, Greece, CIO) agree that:

Change management is the heart of all service management processes. A fine-tuned Change management process can form the strong basis for A successful IT service management approach. This includes constituents that are supporting the Change management process such as the service catalog on which Requests for Change are raised.

(P16, UK, Founding Consultant) extends the aforementioned point to:

Change management needs to be done more formally as opposed to other service management practices.

Whereas (P14, Greece, Head of Applications) adds that establishing a Change Management Office is essential to the success of leading change within any type of organization. The top three challenges identified in an organisation's DevOps practices and principles adoption journey were 1) Poor communication and information flow, 2) Deep-seated company culture 3) Operations not being involved in the requirements specifications.

DevOps is highly regarded as a group of practices and principles that characterise collaborative culture [31] and these top three challenges indicate the requirement to address them from an organisational culture perspective. However, structured IT service management approaches should also be part of the picture that can pose as a threat or a driver to DevOps adoption. More specifically, (P4, UK, Principal Consultant) stated that:

DevOps would not be as successful if there weren't any structured approaches to Change Management and Release and Deployment Management.

According to answers from Q4, 66% of participants is aware of what is DevOps and its associated practices and principles. Therefore, naturally the participants were asked to define DevOps. The most popular phrases in these were "shift of mindset", "enhanced collaboration and communication", "continuous deployment" and "automated testing process".

Moreover, 53% believes that the DevOps leader role should be an individual professional whereas 33% would trust the role to a team. An interesting perspective of having an individual lead the DevOps adoption and organisational transformation efforts initially and then transition to a team effort was also deducted at 13%. Note that the adoption efforts should be of continuous nature and not in project-based terms with kickoff and closure dates. In this context, (P18, UK, Managing Director and Lead Consultant) stated that:

DevOps adoption practices and principles should not be viewed as a project under the context of a transformation with a beginning and an end rather a continuous aspiration for improvement of the current state of adopted practices and principles.

The leadership skills that seemed to stand out as a group of their own and mentioned by 50% of interview participants were 1) technical background, 2) negotiation skills, 3) communication and collaboration skills, 4) previous experience on transformation with 5) holistic systems thinking being mentioned 27%, 6) business background 17% and 7) strategic thinking 13%. Notably, (P13, Greece, Deputy CIO) stated that continuous education should always be part of readiness planning in the DevOps leader

role and as added by (P15, South Africa, Principal Consultant) someone who should have the ability to energize, (P14, Greece, Head of Applications) inspire and engage with the DevOps cross-functional team.

Considering DevOps leadership objectives, remarkably 87% of interview participants agreed that DevOps practice adoption should be extended in an enterprise-wide fashion and also aim to include external service providers of the organisation in its scope. Lastly, the organisational teams should be part of a DevOps practice adoption journey are IT Development (97%), IT Operations (97%), Quality Assurance (93%), Information Security (80%) and Board of Directors (73%).

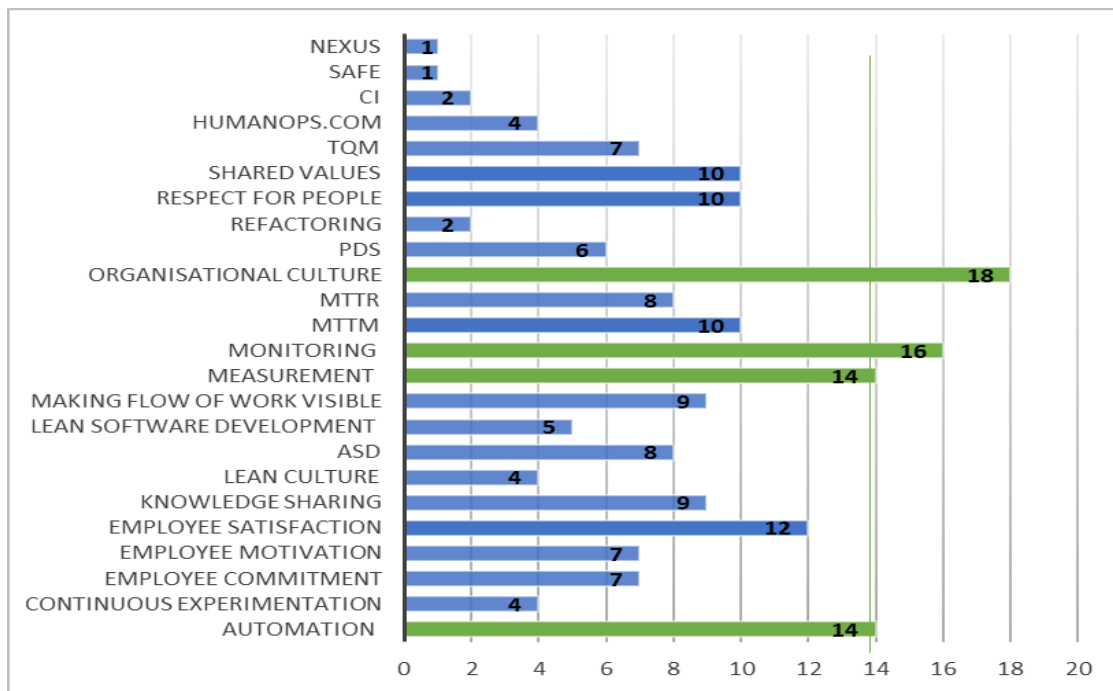


Fig. 3. Agile and lean principles (Top 4 highlighted) [interviewee count: 30].

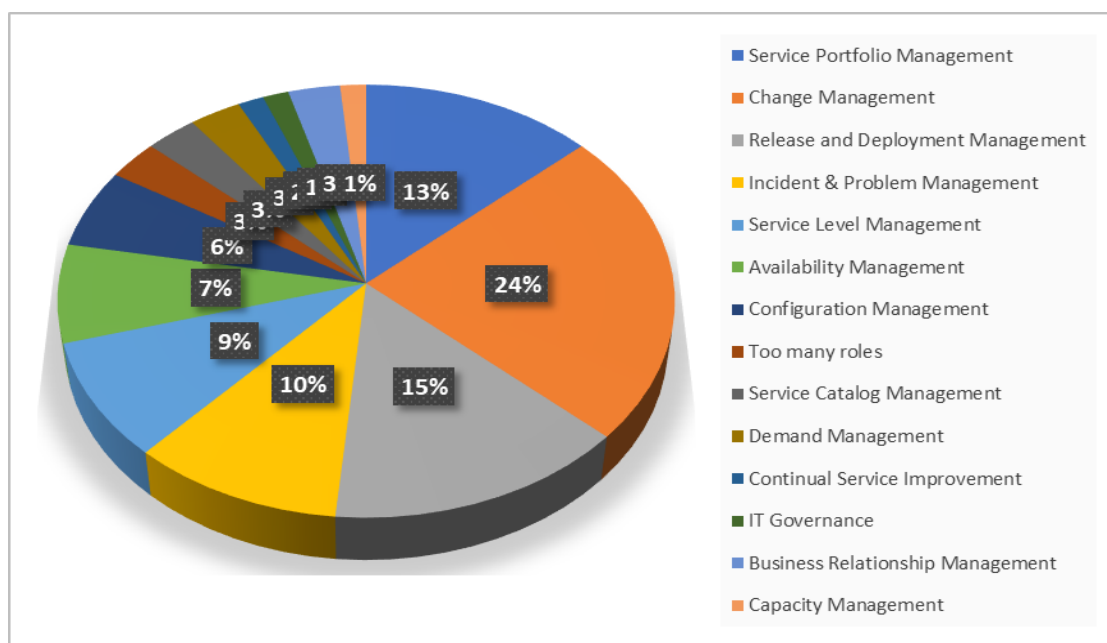


Fig. 4. Beneficial IT service management processes to value delivery of software development [interviewee count: 30].

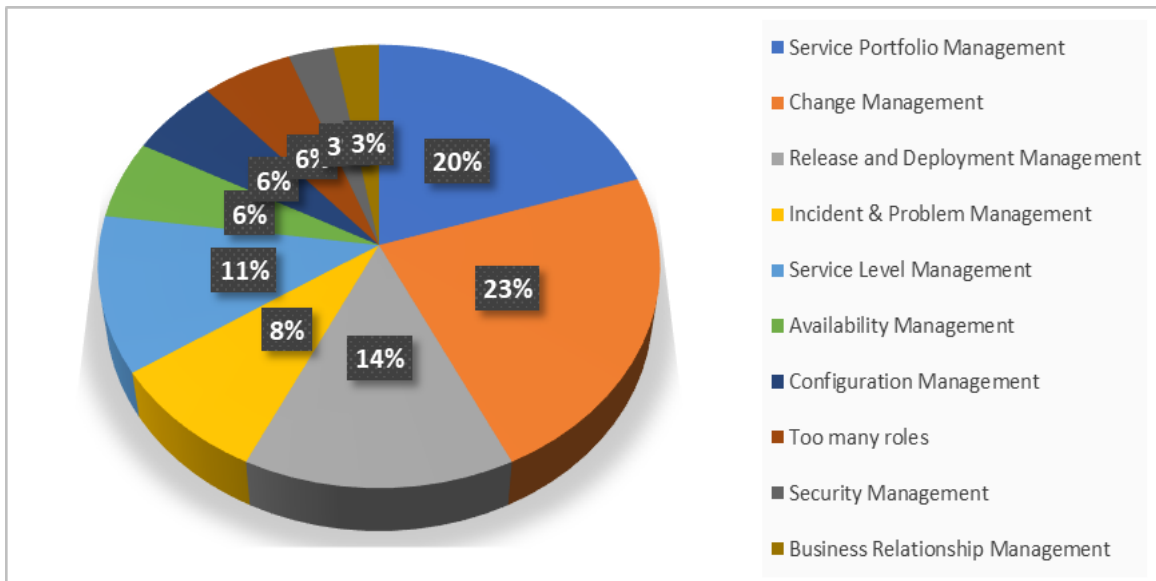


Fig. 5. IT service management processes regarded as impediments to value delivery of software development [interviewee count: 30].

5. Threats to Validity

Concerning construct validity, there is heavy reliance on each of the interviewed practitioners' subjective perception. However, currently there is no objective approach to measure whether or not a DevOps transition journey, in the context, of practice and principle adoption within organisations can be associated to successful outcomes. The semi-structured interview series approach undertaken offers rigorous procedures for data analysis but with a certain degree of research bias. It is probable, that other researchers might deduce different findings and outcomes looking at the same set of data but the author believes the main perceptions would be preserved. This is a typical threat related to similar studies, which do not claim to generate definitive findings.

The author welcomes extensions to the research or potential discovery of new dimensions for future study. Future work can focus on the identification of DevOps adoption leadership styles or leader characteristics that could "make" or "break" a transition journey towards a DevOps-oriented organisation. Furthermore, concerning external validity, although the viewpoint of the interviewed practitioners is considered with different backgrounds, working in organisations from nine (9) different industry domains and ten (10) different countries the author does not claim that research results from this contribution are valid to other scenarios. However, saturation was achieved after the 20th interview..

6. Conclusion

The data collected from a series of interviews and participating practitioners, indicate a clear list of specific agile, lean and DevOps practices and principles that regard an extension to structured service management approaches and are relevant to DevOps adoption theory. The main findings associated to the research questions are shown in Table 6.

The outcomes of this paper can be further evaluated and reused by practitioners in software-intensive organisations willing to introduce a DevOps orientation in terms of practices and principles adoption in the product development lifecycle. The research can be extended in the future to explore more of the different facets of leadership style(s), capabilities, skills and competencies required in the context of continuous DevOps adoption. In particular, a question that could be posed, is to explore why specific leadership styles

have a higher degree of impact on the performance of DevOps teams within an organisation.

Table 6. Research Questions to Findings Mapping

Research Question	Finding
R1	<ul style="list-style-type: none"> Specific agile, lean and DevOps practices such as 1) organisational culture, 2) monitoring/measurement, 3) automation are crucial in the software development lifecycle. Specific agile, lean and DevOps principles such as 1) SCRUM 2), Kanban 3) Continuous Delivery are crucial in the software development lifecycle
R2	<ul style="list-style-type: none"> The set of service management processes that continue to form a strong part of DevOps-oriented structures are Change Management, Service Portfolio Management (including Service Catalog Management), Release and Deployment Management and Service Level Management
R3	<ul style="list-style-type: none"> There is overwhelming consensus that a DevOps leadership role should exist (86%) and that the role should carry a continuous effect not a project-based. DevOps practices and principles adoption are challenged due to poor communication and information flow, deep-seated company culture and operations not being involved in the requirements specifications. DevOps practice adoption should be extended in an enterprise-wide fashion (87%), with team structure based on existing Development (97%), Operations (97%), Quality Assurance (93%) and Information Security (80%) teams.

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