Exposing the gap between Automotive and Cloud Requirements Engineering Practices

A Mixed Method study on Automotive and Cloud practitioners

Bachelor of Science Thesis in Software Engineering and Management

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A Mixed Method study investigating reflections of Automotive and Cloud professionals on RE practices, importance of prioritisation, and perception of new technologies

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***Abstract*—Vehicle-to-Cloud based systems require the engineering of both Automotive and Cloud components working in harmony. On a larger scale, these systems require collaboration between Automotive and Cloud domains or industries; however the problem of compatibility of Requirements Engineering practices, use of prioritisation and outlook on new technology arises as a consequence. Using a Mixed Method study, we interviewed nine professionals within either Cloud or Automotive, to get first hand accounts of Requirement Engineering practices, methods of prioritisation, and their impressions of the effect of future Technologies on Requirements Engineering. Through the use of interviews and subsequent surveys, using Thematic Analysis, we drafted themes to help us conclude on interviewee testimonies. The results showed that both Cloud and Automotive used similar RE practices but differed in the way they prioritised requirements due to a misalignment where Cloud focused on Security and Automotive on Safety. Both however, recognised the possible contribution of new technology on Requirements Engineering but cited the strict regulations in their company and well established Requirements Engineering processes as reasons that new technology will only remain a help to existing processes rather than changing or replacing them.**

***Index Terms*—Requirements Engineering, Automotive, Cloud, Software Development Methodologies, Vehicle-to-Cloud, Emerging Technologies**

I. Introduction

New solutions are being used to overcome the challenges posed by the growth of urban cities, where 70% of the world's population is predicted to live in 2050, contributing 75% of global energy use [1]. In order to facilitate efficient Public Transport Solutions, current Smart Cities have implemented GPS tracking, Internet of Things (IoT), congestion control, real-time traffic monitoring, and many more in current Public Transportation (PT). However, these diverse solutions, that often rely on Vehicle-to-Cloud (V2C) communication, are complex and difficult to manage.

The efforts of V2C allows operators of vehicles to benefit from real time tracking [2], congestion control using dynamic maps [2, 3], active infotainment and navigation techniques, among others [2, 4]. V2C enables vehicle manufacturers to offload some of the compute power required for modern infotainment, navigation and fleet management systems [5] to Cloud resources in an effort to decrease reliance on on-board computers [2].

Current Cloud providers enable large computational power and low power constraints for vehicles in V2C applications which otherwise have limited capabilities and strict power constraints. Lampe et al. also notes that V2C systems have more computational headroom for heavy computation [6]. A limitation of V2C is the upgradeability and updateability of its systems, representing both the ability for the system's physical components to be upgraded and the ability to update electronic systems on a software basis. The rapid progress of more complex software that current hardware is unable to support, questions the ability for V2C systems to remain dynamic and adapt to new trends and technologies [6].

Requirements Engineering (RE) within Cloud Computing and Cloud based applications need to account for the dynamic shifts in Cloud Computing, meaning methods to elicit, analyse, specify and manage needs to reflect these shifts [7]. The limitation therefore accounts for a need to investigate RE for V2C systems in order to understand how the industry adapts to current hardware specifications while meeting the demand for new software innovation as well as being able to dynamically update and track all requirements for Cloud systems.

Automotive is a collection of hardware components and proprietary software intended to monitor and control functions of the vehicle [8]. They undergo rigorous testing in order to ensure they meet targets for safety critical functions as well as satisfy environmental constraints within the car such as heat exposure, durability and longevity [8]. In addition to the increase of software complexity, Staron outlines how Automotive systems increasingly become software projects and focus more on the engineering of software into hardware rather than innovation in its entirety [9]. Therein, Staron states that the increase of software marks the shift towards increased agility of RE as well as focus on Security as the domain for RE and a particular focus on non-functional requirements [9].

As previously stated, Cloud computing has limitations both in how it can be applied as well as how it needs to be developed [7]. Additionally, Embedded systems, which comprise the essence of Automotive hardware and software interaction, have limitations around the strict nature of requirements and their uncompromisable stance on Safety as well as the decaying nature of hardware in relation to the constant development and complexity of software that runs on the hardware. There are clearly differing priorities for Automotive and Cloud, which may have implications on the RE practices done within each domain.

There are no specific cases where there is an analysis of RE practices for V2C systems as a whole, neither investigating the RE required for developing communication between Automotive and Cloud systems. This is marked by the discrepancy of RE practices between the different aspects of the V2C, leading to challenges of upgradeability and updateability of systems. The aim of this study was to expose the gap between Automotive and Cloud RE practices; furthermore, understanding if RE practices can be unified or remain separate processes for V2C system development. The gap was exposed through the Mixed Method approach [10], which consisted of conducting interviews with professionals who have worked with either Cloud solutions or Automotive solutions. Therein we focused on gathering first-hand accounts of RE practices and how the companies account for new shifts in technology which might challenge the existing RE practices and possible collaboration between Cloud and Automotive. We followed these interviews with an unsupervised survey to see if the perception of themes generated from the thematic analysis of our interview was shared among all participants. Upon analysis of this data, it allowed us to provide insight into the RE practices and evaluate them based on the gap presented in the literature. We saw how RE practices for these domains relate, highlighting their similarities and differences, and exposing if the gap is as present as the literature states.

II. Related Work

This section deals with the the fact that the main contributions for Requirements Engineering (RE) for Vehicle-To-Cloud (V2C) are two fold: on the one hand discussion of RE practices for Cloud computing which outlines the development of the Cloud aspect of V2C and the other is RE for Automotive systems which discusses the Automotive aspect of V2C. Both will be discussed in the following sections to establish a background of RE practices as well as to discuss their shortcomings when done in combination for systems such as V2C. The aim is to expose the missing literature surrounding RE practices for V2C and if RE practices for Automotive and Cloud can be unified in the development of V2C.

A. RE for Cloud Computing

The differentiation from traditional RE practices within RE for Cloud Computing is marked by how they adapt to the stakeholder's needs and what technologies it is meant to support. Wind et al. found that the common pitfalls for traditional RE models within Cloud Computing applications, lead to their inability to adapt frequently and quickly enough for the consistent changes in requirements and stakeholder needs [11]. This in-turn reflects issues of unclear requirements due to the variability in their origin, as stated by [12]. Within conclusions by Wind et al, Zalazar et al. discussed that due to the nature of Cloud Computing, requirements need to be traceable so that when requirements shift, there is accountability for all requirements after the fact, showing just how volatile these requirements may be [7]. Zalazar et al. followed this by stating how legislative changes, introductions of new organisational policies, new technology and a shift in the environment and marketplace are the leading factors for the consistent change in requirements and RE practice for Cloud Computing.

While RE practices within this domain remain dynamic, Zave et al. highlight that RE in Cloud focuses on real world goals for functions and their constraints to compensate for the consistent shifts, which are more stable and thus permeate through down to requirements regardless of shifts that occur during the project's life cycle [13, 14]. The way in which RE in Cloud Computing interacts with other more definitive RE practices needs to be addressed given that the environment for RE as highlighted above cannot be applied to or unified with other RE practices for development of V2C systems.

B. RE for Automotive Systems

To highlight how RE for Automotive systems differs from RE practices within Cloud Computing, Staron states that RE practices within the domain outline different types of requirements based on the decomposition of aspects of the car, from parts all the way to entire systems [9]. In their paper, RE is presented as a process rather than individual innovations, leading to the understanding that RE for Automotive systems focuses on the engineering of systems as a whole rather than specific aspects of the system. Within [8], Staron's sentiment is reverberated in that requirements are split into levels of abstraction for the vehicle's system, filtering down levels as a means to capture all requirements for a vehicle and its systems. The rigorous RE process within insists on the break down of core systems-of-systems, prioritising and grouping requirements; however, these RE practices lead to issues with inconsistencies and ambiguities [8, 9] further in development which produce problems with adaptability in integration as a consequence of inflexible RE processes.

Based on the aspect of decomposition, we introduce heterogeneity within the RE practices, as different aspects of Automotive Systems require different processes [15]. Wohlrab et al. mentions that with heterogeneity and diversity, mechanisms are required to collect and understand created RE practices [16]. This requires more consolidation practices within the Automotive RE practices, which means more upfront planning for how RE practices are outlined to elicit the right requirements for the right system. The same cannot be said for RE for Cloud Computing which is more fluid and usually does not need to be broken down, creating a misalignment in RE practices.

C. Limitations of Current RE practices

Within SE in the Automotive Domain, the amount of requirements for one car model can exceed 20,000 pages [17]. Despite the detail in which producers of Automotive systems define requirements, the requirement can lack certain details which creates potential gaps leading to inconsistencies with

Original Equipment Manufacturer (OEM) manufacturers [18]. The high amount of requirements also leads to more requirement reuse, moreover, new requirements might appear too late in the lifecycle of the intended product, meaning that new systems contain old functionalities rather than new ones [17, 19]. In addition to this, RE practices tend to elicit requirements for leaf-nodes of the product [19], outlining small features as part of the entire system to avoid the cost, constraints, time lost and risk of redefining system wide and broader requirements for the product.

The heterogeneity of vehicles within V2C systems leads to a lack of control on which Cloud provider the data is sent to, requiring a standardized system for all vehicles to be able to collect, process and analyze data on a centralized Cloud system [20]. This highlights a limitation within Cloud computing for V2C as there is no enforcement of standardisation that can lead to the required cohesion reflected in V2C. This trend establishes a common dissatisfaction for RE for Cloud computing which needs to align with their Automotive counterparts as well as need to establish common RE techniques to understand how Cloud computing and Automotive systems are developed in unison.

The limitations discussed impair the upgradeability and updateability of current RE practices given that requirements are often reused for Automotive systems while requirements for Cloud based systems dynamically change based on all sorts of things [19]. Another point to be made is the prevalence of new technologies and their effect on the topic of upgradeability and updateability. [21] discusses a potential gap between RE practices and Machine Learning (ML) applications, highlighting the fragility of current practices facing the scrutiny of implementing new technologies. An evaluation must be made on current RE processes to see whether the divide between Automotive and Cloud is currently present or RE processes for both these domains can be unified.

Currently there exists little to no research on the engineering process behind Vehicle-To-Cloud systems. The gap identified is that there are RE practices described for both Cloud based computing systems as well as for Automotive systems, both of which need to work uniformly to create V2C systems. However, both RE practices greatly differ in their processes, requiring an analysis each of their RE practices in an effort to understand how Cloud and Automotive entities do RE, how prioritisation occurs with the requirements elicited, and how this reflects on the extensibility of these systems based on their RE practices. The process of doing this exposes why there are no current investigations into the RE process for V2C and if or why RE practices are separated for the differing aspects within V2C, namely Automotive systems and Cloud computing systems.

III. Research Methodology

To further answer the nature of our research, we established the following research questions:

RQ1: What industry practices are employed for RE for Automotive and Cloud systems?

Reasoning: This research question allowed us to establish a baseline of how RE practices are done by respective companies, as well as creating a better picture of the companies' current process of establishing requirements. We focused our efforts on asking specific questions to both Automotive and Cloud practitioners in order to see the entire RE process. Therein, we highlighted on both similarities and differences in Automotive and Cloud RE practices, leading to further reflection on how these domains remain different in several aspects but similar in most practices.

RQ2: What key aspects are prioritised when working with requirements for Automotive and Cloud systems?

- **RQ2.1**: What is the criteria that supports the prioritisation of key aspects of Automotive and Cloud systems?

Reasoning: While RQ1 enabled us to understand the current RE practices as a whole, RQ2 highlighted the prioritisation of requirements within RE as well as a perspective of which aspects influence the order of requirements. Prioritisation allowed us to see the order of importance during development. Being able to see both sides of Automotive and Cloud and how Requirement prioritisation occurred gave us crucial insight into the scale of importance that these domains place on requirements and what they based these prioritisation on.

RQ3: How do new technologies affect RE practices within Automotive and Cloud systems?

- **RQ3.1**: How adaptable are current RE practices for new technologies within Automotive and Cloud systems?

Reasoning: Based on the result of RQ1 and RQ2, through interviews, the study uncovers whether current RE practices account for the growing gap between Automotive and Cloud. This gap exposed whether or not current practices hold up to rapid innovation and if the downsides of current RE practices are to blame for this gap. In addition, the investigation of new technologies highlighted how RE practices are effected as well as showing how they adapt to a growing demand of these technologies. This served the purpose at showing if RE practices are shapeable to these technologies or to highlight the stability of these practices regardless of the new technology introduced.

A. Overview

This research used a Mixed Method Study [10] approach, employing a Sequential design. With the help of semi-structured interviews, we gained an understanding of RE practices and how it may allow a possible collaboration between Automotive and Cloud providers to create V2C solution. The results and subsequent themes found through Thematic Analysis helped formulate a follow-up, unsupervised survey, to confirm if interviewees agreed that the Themes reflected what was stated and what is being done at their place of employment.

a) Why use Mixed Method for this research?: The reason mixed method is being used is because our study required personal insights into how RE practices are being conducted within companies. That way we were able to give an account of first hand experience in RE practices for Automotive and Cloud. The experiences from the practitioners allowed us to formulate initial conclusions on a personal basis which require additional corroboration to solidify any claims. Hence, we used a follow-up survey, constructed from the Themes created by interview results, to collect further Quantitative data. This data serves the purpose to confirm our Themes and to achieve an agreement among all interviewees, which gives additional nuance and supports our findings.

b) What is the context and Why?: We started off looking at the Gothenburg area for our study, as it is a hub for the Automotive industry, where a lot of software projects are conceptualized for Automotive systems. However, in the end, we branched out to a European setting, finding several companies who fell within our criteria of either Cloud or Automotive, or both. The companies we ended up interviewing specialized in building Automotive solutions, as well as companies who engineered Cloud solutions for large software systems. Whilst the companies produced different products, all of them applied to our study by aligning with either the engineering Automotive or Cloud solutions. These companies provided our population, which consisted of practitioners who work with or on RE practices within the companies described above. The difference in expertise from all practitioners allowed us to compare and contrast the RE techniques as well as how well prepared RE practices are for future technologies.

B. Data collection

For our primary data collection, we used convenience sampling to find participants from companies within Europe who were either situated within the Automotive sector while others were working with Cloud applications. Initially, we focused on garnering companies who worked on specific V2C implementations; however, due to time constraints, we refocused on Automotive and Cloud and which companies work with those. This way we were still able to receive input from both main parts of what made up V2C systems without having to target fewer companies who worked with V2C solutions. Within chosen companies, we made sure that subjects worked within RE practices or were exposed to RE within on of the constituent parts of V2C. Our choice of convenience sampling is justified by the lack of time or resources companies often have, which limits the overall population we can draw samples from. The subjects for our interviews have worked with products and solutions within the Automotive or/and Cloud domain. The subjects did not have any specific role and can range from developers to managers; however, our intention was to only include subjects who have been exposed to RE practices within the chosen domain.

Prior to the main interviews, we conducted a pilot interview to refine our interview guide. According to Majid et al. piloting plays a crucial role in ensuring the clarity, relevance, and effectiveness of interview questions [22]. The pilot interview allowed us to identify and correct potential misunderstandings or ambiguities in the questions, thus enhancing the interview guide's ability to elicit meaningful and detailed responses. The knowledge acquired from the pilot interview, helped us refine questions within the guide in order to make sure the research questions are answered more effectively.

We used a semi-structured interview approach based on our interview guide. This was our primary instrument and was created by deconstructing Research Questions into viable interview questions. The instrument was refined through the insights gathered during the pilot interview. The following interview guide is shown below as Table I. The purpose for asking about Embedded experience and systems was to highlight the fact that engineers worked within low-level systems and interacted with hardware within Automotive companies. This is also a reflection of why *we chose to add 'embedded' as part of interviews* as we wanted a certain degree of technical expertise, working with the hardware in order to get the answers to our question without too much abstraction and nuance. This way we made sure that participants are relevant for the study, giving a technical perspective on the Automotive domain of V2C. Overall, we expected at least ten interviews with industry professionals, as we believed that this would give us enough variation in our data while still reaching a point of saturation, from which we could answer our research questions effectively. We ended up conducting nine interviews from five different software companies. One of these interviews was a pilot interview thus leaving us with eight interviews from four different companies on which we were able to conduct our data analysis onto.

Following these interviews, we administered a follow-up survey to each of the participants, all of which were part of our interview population, in order to obtain quantitative data in the form follow up survey answers. This survey was specifically created from the Themes generated and acted as a confirmatory method to get the general consensus on the themes we found. Under the appendix, Table V shows a table of survey questions with their corresponding question type and Theme they map to. The types of questions often depended on the theme we were trying to get agreement on, either asking if they agreed with theme, how frequently the theme occurred within their work, and choosing which option reflected the theme best within their employment. The survey was sent out after Thematic Analysis were concluded and was sent out May 1st, 2024 and was open for at least 2 weeks to ensure the most amount of people answer the survey. We similarly expected to receive the same amount of responses as participants for our interviews, which is around eight, with the pilot interviewee not receiving the survey. We opted out of doing a pilot survey due to time constraints. Ultimately we received eight responses for our survey.

The collected data primarily consisted of Qualitative data in the form of transcripts and supporting notes collected during the interviews. Depending on the consent given, we also recorded and transcribed our interviews for a further source of data and to increase the accuracy of the transcripts. The reason for collecting all these types of mediums was so that we did not miss crucial talking points within the qualitative data. When formulating the transcripts, we purposely created

TABLE I
INTERVIEW QUESTIONS

RQ	Interview Questions
NA	1. What is the size of the company you work for? 2. What is your overall development experience in years? 3. What is your Embedded experience in years? 4. What is your Cloud experience in years? 5. What is your Requirements Engineering experience in years? 6. How often are you exposed to Requirements per week?
RQ1	7. Can you describe the inception phase of your RE process? 8. How do you identify key constraints in the development of your Cloud or Embedded Systems? 9. How do you ensure that requirement specifications meet stakeholder needs? 10. What is the process of managing requirements based on the system they apply to?
RQ2	11. How are requirements prioritised during the development period? 12. What is the process of ranking requirements within your product? 13. Is there any differentiation in the way you rank requirements based on the system you are building? If so what is the difference? 14. Could you give an example of a situation where requirements were based on other requirements of different technologies?
RQ3	15. How robust are the current RE practices in light of upcoming technologies? 16. Given the emergence of ML algorithms or 6G connectivity, how do you foresee the shifts in RE practices to match the growing demand for these new technologies? 17. Given the size of your organisation, can you identify how these future technologies might impact the way RE is conducted?

Verbatim Transcripts to be able to cover all words spoken and still capturing the meaning of the text without wasting time for editing out unnecessary words. The surveys consisted mainly of Quantitative data, existing to further corroborate conclusions stated during the interviews.

Microsoft tools was used for data collection and analysis of results, all of which were provided to us by the University License. In our case, interviews were recorded, using Microsoft Teams, with additional consent from the interviewee. Additionally, the built-in voice-to-text transcription feature of Microsoft Teams was used to create the bulk of the transcripts. This transcription also does not capture all of the words spoken which is necessary for Verbatim transcription; therefore, the voice recording is used to fill in those gaps. To distribute and collect survey information, we used Microsoft Forms as the main tool to effectively obtain the quantitative responses from subjects after their interviews. We subsequently stored all transcripts, recordings and further data in our Universities Microsoft One-drive.

C. Data analysis

In this study, we used Thematic Analysis (TA) as described by Braun and Clarke, to analyse the qualitative data obtained from the semi-structured interviews as well as the few open-ended responses within the survey. Braun and Clarke describe TA as “a method for identifying, analysing, and interpreting patterns of meaning [of themes] within qualitative data” [23]. Applying this framework provided us with a structured yet flexible means of retrieving the subtle insights found within the interview data collected.

Initially, we started with the process with data familiarisation, getting familiar with each interview by means of reviewing the created transcript. Each transcript was thoroughly proof-read individually, then together, in order for us to understand the material. We discussed creating initial codes to lay a foundation for thematic exploration; however, decided against such an approach due to the specificity of the data. Braun and Clarke emphasise TA’s unique position in qualitative research, being “unbounded by theoretical commitments” [23]. To complete coding, we used ATLAS.ti to create and manage codes for our research.

We chose the inductive coding approach which meant that codes emerged directly from data after both coders had extensively reviewed the material. To measure inter-coder reliability, we completed a coding round after the individual coding round, after which we calculate the amount of agreements divided by the total categorical assessments made. These assessments encompassed the choice of code, the text highlighted and the meaning of the code for the text. If these were agreed upon it would count as an agreement, adding to the percentage. The goal was to achieve as high a score as possible; however, as it was our first time coding Qualitative data, we aimed to achieve a final inter-coder reliability score of 70% according to Percentage agreement chart [24]. We believed that this score was satisfactory to safely assume that both coders understood the material and made the same conclusions on the relevant parts of the transcripts so that we may proceed with drafting themes.

Once the coding was done and we achieved the satisfactory inter-coder reliability, as seen in Table II, the next step was to search for themes. This included organising the codes into probable themes and sub-themes that captured the prevalent patterns across the data set. Codes were categorized according to how similar they were, leading us to form groups of codes which resembled the eventual themes we encountered. In this process, made theme generation smoother by creating better formulated codes and reducing the total number of codes to chose from. According to the approach by Braun and Clarke, we had to begin with a comprehensive review of themes across the entire dataset [23]. This consisted of a two-phase process: first, assessing each theme in relation to coded extracts, and then, against the entire dataset to guarantee a cohesive narrative. This thorough examination ensured that the themes accurately reflected the core of participant stories while also aligning with wider research goals.

TABLE II
ICR PERCENTAGE MEASUREMENTS

ID	ICR %
P1	60.9%
P2	69.2%
P3	59.1%
P4	73.7%
P5	63.4%
P6	62.2%
P7	70.5%
P8	74.1%
Average	66.6%

The themes then formed the basis of our survey questions. Within themes within Figure V, some of them required more specific questions to be able to say that the theme was agreed upon. Question 5, for example, was addressing the sub-theme of "Drawbacks of standardized RE practices" and required multiple choice rather than a Polar question to be able to see what the drawback most participants experienced was. This created a level of agreement for the sub-theme in particular as it showed that there are common drawbacks to the current RE practices. In other cases it was important to demonstrate agreement by making participants measure how much a certain theme reflected in their work such as questions 8 and 9.

For the limited quantitative data that we collected, as a result of the survey, we created visual graphs with the help of Microsoft Excel. The purpose of these graphs was to provide more context from the interviewed subjects. This data did not require any extensive analysis other than creating plots or graphs, all of which were labelled and displayed in the results section, helping us outline the responses of the survey.

IV. INTERVIEW RESULTS

After collecting the data, Table III shows the interview participant's experiences overall, as well as Figure 1 both their Automotive and Cloud experiences as well as the current job title. All of this in accordance with their consent and a signed consent form. This data shows the range of experience of the participants to give context on some reflections they may have. The participants are marked with an ID which is used to add references when summarizing or quoting what they said to answer our questions.

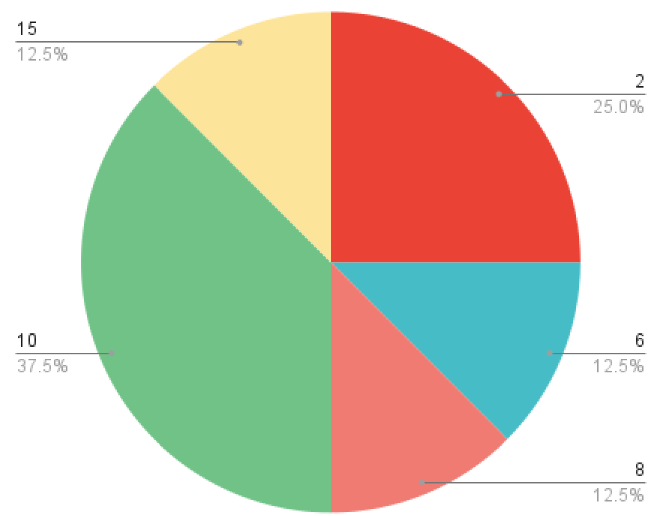
Within our interview population, not including the data collected from the pilot interview, five of the participants were involved in Cloud Computing, and their Cloud experience varies from one to six years. Three of the participants have been involved in the Automotive domain, and their Embedded experiences varies from one to 10 years. When quoting a participants statements and placing it in this study, we edited words and sentences so that their quotes were legible.

Pohl describes the RE as a cyclical process with four key steps: elicitation, specification and documentation, validation

TABLE III
INTERVIEW PARTICIPANTS

ID	Job Title	Dev. Exp.	Embedded Exp.	Cloud Exp.
P1	Cloud Platform & Infrastructure Tech lead	18 years	0 years	5 years
P2	Cloud Platform & Infrastructure Delivery Lead	23 years	0 years	6 years
P3	Test Automation Officer	2 years	0 years	2 years
P4	Enable Delivery Tech lead	7 years	1 years	4 years
P5	Test Automation Developer	2 years	0 years	1 year
P6	Software Engineer	10 years	10 years	1 year
P7	Software Engineer	10 years	8 years	1 year
P8	Senior System Safety Engineer	8 years	1 year	0 years

Fig. 1. Percentage view of developer experience (in years)

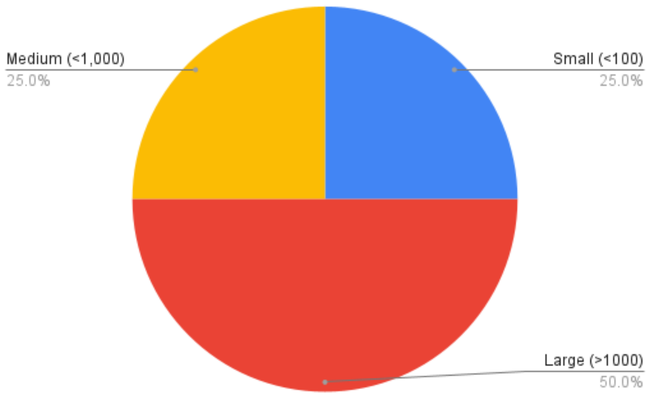


and verification, and negotiation; therefore, creating the structure for the following results [25]. The reason for such an organization was to highlight the reflections at each stage of the RE process, indicating what practices were done at each stage.

It was important for us to highlight each stage, so that we would be able to list individual practices done within both Cloud and Automotive. While we highlight RE practices at each stage of the RE process for both domains, we required separate sections to elaborate on further findings,

The themes are presented as Figure IV below, which were referenced alongside testimonies from interviewees. We mentioned themes in the interview results; however, the themes were mainly discussed in the survey results section, as each theme required a general agreement from participants to be accepted in this research. This mirrors the Mixed Method approach which emphasises the importance of agreement on themes in order to have relevance to the study.

Fig. 2. Percentage of Participants that come from specific Company sizes



A. Feasibility Study

As participants belonged to large companies, they all discussed what the literature describes as a feasibility study which was done to ensure that the RE process is possible on a Financial, Operational and Technical level [26]. The purpose of mentioning this Feasibility Study is to grasp the full perspective of the RE process from inception all the way to deployment or release, ensuring that the software or system can be built, operate and maintained within the organisational confines.

Within the first aspect of financial constraints, unsurprisingly, our results on the Cloud domain showed us how cost was a strong indicator influencing the feasibility of a project. Notably, P1 stated the following regarding a cost perspective to determine feasibility of a future project:

> "Now, with Cloud, we are able to provide cost estimations before provisioning the infrastructure and then to adjust based on need." - P1

They later doubled down on this testimony, reflecting that FinOps, or Financial Operations, as a concept, is integral to their operations, stating how its integration within their Development/Operations (DevOps) platform. It enables both cost estimation as well as cost monitoring for their Cloud services in a continuous manner, allowing Proof of concepts or prototypes to additionally prove the feasibility of a project on a financial aspect.

Automotive experts did not reflect on the financial aspect when it came to the feasibility of any project they were apart of. P8, however, echoed the desire to for Continuous Integration/Continuous Development (CI/CD) stating that with the "rapidity of DevOps in Automotive, the aim is weakly updates maybe" while still reflecting the limitations that Automotive brings, stating "that's very, very impossible in Automotive, because we have so many gates that they need to be checked before something release, and some of them they they take maybe sometimes even years to be approved and checked". The financial aspect of Feasibility was not reflected on developers we interviewed, suggesting that this was done higher up the hierarchical ladder; however, P8's statement shows the desire for DevOps practices and rapid deployment albeit constrained by the organisational structure.

TABLE IV
THEMES (BOLD) AND SUB-THEMES (NON-BOLD)

Theme	Explanation
1. Regulatory Constraints in development	Indicative of a wider consensus on how stringent regulations dictate development methods and frameworks
2. Importance of Cloud Engineering for Modern Development	Interviewees stressed how important Cloud and proper Cloud-engineering was
3. Role of tools and methods for RE and development	A common reflection was the role of tools in development and how those shaped/organized the way RE and development occurred
4. Limitations of Industry Domain	The nature of the two domains enacted its own set of limitations in creativity, innovation and discovery for developers
5. Established industry practices for development 5.1 Drawbacks of standardized RE practices 5.2 Benefits of standardized RE practices	All interviews reflected current and past RE practices still in use today while citing their benefits and drawbacks in the process
6. Perceived Impact of New technology	Interviewees discussed their opinions on how thoroughly new technology could impact both their work and RE practices
7. Requirements Engineering Processes 7.1 Communicating requirements 7.2 Importance of Prioritisation 7.3 Verification and Validation testing	Many outlined the processes/practices used for RE in their companies, detailing communication of requirements, the importance of prioritisation and verification & validation of requirements through testing

Technological constraints within Cloud development were a big part of understanding the Feasibility Study. Interviewees working with Cloud stated how understanding the system you were building, was a matter of understanding both the technical resources required and the purpose for the system.

The sentiment was echoed by both P3 and P2:

> "...we think about how the system communicates. We consider how the immediate system talks to other devices or systems, and we understand any rules are limits with the communication, like how fast it needs to happen or how much data it can handle" - P3

With P2 following this with a sentiment regarding the origin of certain business requirements, discussing feasibility of a project in terms of how knowledge plays a big part in it all. They say that there is a need to "understand the loads, to understand the behaviour of the application" when designing a system in order to the then "define the resources after some stress testing" in a dynamic way to meet at criteria and requirements.Therein we see that, as Cloud operations work as dynamic components whose traffic and data varies so frequently, it is important to realize how systems interact and what resources are available to both feasibly run the project but also has enough headroom to allow for future additions.

Automotive realizes Technical constraints on more of a hardware and software basis, taking both sides into account to address feasibility of projects. In some cases, the hardware was the focus of technical constraints for some software projects. P7 states that in some cases the following was true:

> "it was a very new component, that was usually outsourced in some other team, there were actually no requirements for the component, I mean we know it must work but there isn't, at the time, there were no feature requirements. So we have to make some of them up, and how that was done that's in terms of how the system needs to work. [...] So while it wasn't an explicit requirement on camera that were working with, it could infer it from the overall system" - P7

Following this by saying that "we should send a diagnostic signal, that was the one requirement, but the actual camera didn't give any." This implies that hardware was the key factor in indicating the direction of where project and features would go.

Operational constraints is the final aspect that determines the feasibility of a project. It refers to the question of "can we support and maintain the product when released?" [26]. The findings for this aspect were disappointing as no interviewee discussed in great depth anything about Operational constraints. A particularly reassuring result showed that in Cloud-based companies, operational constraints were addressed in planning along with the financial constraints as how well something ran, how many users it should support, and how well it should perform, required lots of Cloud resources which, as for the companies our interviewees worked for, ran over external Cloud providers. This would require more forward thinking financially; therefore, operational constraints were figured out alongside aforementioned cost estimations. Another key finding stressed the importance of CI/CD as well as testing; however, this would highlight the strong investment in maintainability rather than expose any operational constraints that required the need for CI/CD and testing.

From our results, the only findings for operational constraints for Automotive were around the legal and organisational constraints that were necessary to ensure Safety was prioritised for a product's lifecycle. P8 established that in development the following was to be adhered to:

> "For sure there are some standards and guidelines for each of those categories. If it's a software and this specific part of the software, there are some well established methods in the standard like ISO 26262 for example, or ISO 21448." - P8

These standards allow potential projects to be held to high standards before conceptualisation and lets any prospective project undergo the scrutiny of "can this be released and maintained" all while complying with the legal and organisational constraints associated with the ISO regulations.

B. RE practices: Elicitation

After the feasibility of the project has been proven, Requirement elicitation is the next step. This involves gathering stakeholders needs using different methods such as interviews, surveys, Prototyping, or document analysis. Every process starts with the needs, and the constraints of a system and it is all about highlighting and mediating the hidden knowledge in a way that everyone can understand [25].

Requirements elicitation in the Cloud domain mostly follow both iterative and Agile methodologies that allow for continuous feedback and refinements of the requirements. From interviewee responses, we were able to identify different methods used, including prototyping and stakeholder involvement. These are prevalent as they provide immediate insights into the feasibility and user acceptance of proposed solutions.

However, managing the scope of a project in the Cloud industry is challenging due to the constant development of features and scalability. Therefore, in the process of eliciting requirements, future expansion and integration possibilities need to be taken into consideration and not only the current demand. Upon asking P1 about these ideas, they presented the following:

> "...we want to use database A and not database B. I'm not putting some names on the technology, but the idea it is that let's say even when it is the solution architects provided let's say we need to take in consideration this part, another part, it is regarding sizing." - P1

This quote emphasizes key decisions made on a high level which affects further steps in the development process. The idea that switching a database, which was used a metaphor for a real technology, meant adjusting sizing, means that a degree of forward thinking is required to understand the scope and requirements that a system might have.

The elicitation process for Automotive industries is formal and rigid to ensure that all facets of the Safety and regulatory requirements are taken into consideration. Through prototyping, detailed requirements specifications, and a broad usage of traceability matrices, Automotive can ensure stringent quality control during the development process of the vehicle. Moreover, in practice, many companies are reusing requirements or staying with legacy requirements and the reason being that companies are trying to reduce costs [25]. This relates back to what [9] mentioned with regards to reuse and subsequent cost reduction as well as reflecting on what insights our interviewees presented the following:

> "It was common that you would revisit some of these requirements that were, very often on a high level, very often inherited from an older project" - P7

While this may not pose a complete picture how the elicitation of requirements actually happens, instead it shows how legacy requirements are inherited to reduce cost. A sub-theme within ***"Established Industry practices for development"*** emerged being ***"Benefit of standardised RE practies"*** whose idea came from the reiteration of the key practice of reuse and how all participants cited its importance and integration. Participant P7 continued from the quote above and the sub-theme, mentioning how they handled legacy requirements as they were "not going to rewrite [requirements], many of the requirements are inherited" however they then stated an interesting point by saying how "many of these requirements aren't valid anymore" implying that re-used requirements were convenient but not always applicable.

These findings suggests that companies are reusing and sticking with legacy requirements with another participant stating the following:

> "I worked in big companies and they had so many legacy requirements that you could reuse, although maybe the system is new or function is novel, there are always some requirements that you can reuse" - P8

A theme that emerged from similar statements was ***"Limitations of Industry Domain"*** which showed the affect the domain has on RE and that limitations often lead to practices like requirement re-use to save time but also to continue to adhere to Safety standards, possibly impairing innovation through new requirements and implementation.

C. RE practices: Specification

Requirements specification (RS) is the process in which all the identified needs from the requirement analysis phase are carefully defined, documented, and visualized using various formal models. This is carefully documented because it serves to capture the functional and non-functional requirements, as well as any constraints or limitations that must be taken into consideration.

Within the Cloud domain, a clear practice was working closely with the stakeholders and ensuring that RS remains clear and legible for all participating parties. The need to ensure mutual understanding across various teams and departments is emphasized, P3 remarking on the necessity of clear specifications:

> "It's not only us who identify those key problems, but it's basically the team or the product that we are going to test... and we also, we also need to talk to everyone involved all the time. Working with any everyone who knows about the system, like engineers and ask the testers, we get through what's most important to test and every, every problem they see. So communication is like one, another part that helps in this process." - P3

Organizing and prioritizing the requirements effectively is critical to managing the development process efficiently. This can be achieved by grouping requirements into more manageable parts and prioritizing them based on their importance and the value it brings, teams can better allocate resources and focus. Participant P1 emphasizes the approach in the following statement:

> "There is no concept of waterfall and stuff like this. So basically the things are a little bit more dynamic, and there are based some kind of plannings and simulations and calculations that are done on Sprint levels... [with] frequent changes, but split in pieces." - P1

In regards to RS, this statement shows that prioritisation as part of managing requirements is a key practice to achieving both consistent requirement lists as well as making sure that there is a clear direction for the future development of features.

According to the data, Jira facilitated the RS process within the Automotive companies we interviewed, providing a structured and visual means to document, track, and manage requirements as they evolve from inception to completion. For instance, P6, from the Automotive domain, emphasized the benefits of using "Jira for our own development tasks", being able to link "it to Jenkins to see if the uh, to see the state of the tasks" in order to manage and track requirements from inception down to individual features. This recurring tool helped us establish the theme ***"Role of tools and methods for RE and development"***; however, this theme did not help our research efforts and was noted as being out of scope for the current research questions. To our chagrin, Automotive experts offered little else regarding Requirements specification, elaborating more on other parts of the RE process.

D. RE practices: Validation and Verification

The crucial step of validation and verification (VV) of requirements revolves around making sure that all requirements are achievable and do not conflict with on another. Therein, requirements are checked to see if they still reflect the stakeholder needs and expectations all the while checking that these requirements are still satisfiable on a development perspective.

The results of our study were significant in at least two major respects: on the one hand, we saw how focused Cloud really was on testing and on the other hand we understood why testing was crucial to the success of future software products. Upon asking P5 if requirements were tested prior to their implementation, they cited the use of "exploratory testing, which actually revealed to us a lot of these constraints that we will face later on" giving the company the ability to "find these constraints within this testing phase" and to point them out to development team and stakeholders.

While this may not pose a complete picture of the full range of techniques, exploratory testing helped to expose faults in system requirements as well a provide feedback on constraints for future stakeholder discussions and for further clarification of these requirements. While exploratory testing can be used at several stages of development, P5 continued from the quote above to state that:

> "We communicate them, but if we don't find them, sometimes it happens that these constraints appear later on while we are implementing, it would put our process in hold for the very moment" - P5

This shows that finding constraints was a crucial point understanding if Requirements fully encompassed the system and if they met stakeholder needs. P1 stated that, in making sure that requirements met stakeholder needs "you start with a minimum requirement that are needed" and "you can play and fine tuning these parameters based on the usage" implying the ability to adjust based on base requirements and scale up to meet more demand. This quote further reflects how requirements can change dynamically within Cloud and that at any point there can be a shift in what the product is intended to do. This use of testing shows how requirements are never fixed but rather a starting point from which developers have an initial guide that is to be improved and updated in further development stages. Therefore, the sub-theme ***"Verification and Validation testing"*** was conceptualised within the main theme ***"Requirements Engineering Processes"***, as many participants highlighted that Verification and Validation were important mediums to ensure that products did what they were supposed to do.

Verification of Requirements in Cloud was done by involving the stakeholder in the process, keeping them in the loop regarding significant changes. This practice was stated by several interviewees:

> "...I'm getting involved in meetings with stakeholders that explain the requirements to us" - P5

With P2 reflecting on a similar question stating similar points regarding stakeholder communication:

> "We can, we can communicate directly or via demand management. The requirements came from management and then if there is some further analysis or any, you want to understand more we can we can communicate directly with the, with the business users." - P2

What connects these quotes is the ability for Cloud professionals to have continuous dialogue with stakeholders to fully understand requirements as well as to clear up any confusions there might be. It serves the purpose that the requirements can be openly discussed with stakeholders during any phase in development, giving developers the freedom to address any issues that may appear in development. Any further practices for VV were not really mentioned by interviewees.

Unexpectedly, the results from Automotive professionals offered few results concerning Requirements VV. Within our results, requirements were often re-used, as P7 states:

> "It was common that you would get, introduce, or revisit some of these requirements that were, very often on a high level, very often inherited from an older project like ... not so surprisingly they don't rewrite all the requirements." - P7

P8 stated similar things, albeit reminding us that regardless of company size, Automotive had pre-existing requirements which allowed them to adhere to Safety and legal standards and saving time and resources for project inception as well as project lifecycle.

> "Because I worked in big companies and they had so many times legacy requirements that you could reuse, although maybe the system is new or function is novel, but there are always some requirements that you can reuse them and basically build up the system based on them." - P8

Our findings present the prevalence of Requirements Re-use as the sole practice which Automotive experts cited, which saw pre-existing requirements that were already established, verified, and validated before the tenure of any of our interviewees.

E. RE practices: Negotiation

The process of Requirement negotiation is responsible for deliberately establishing agreements with stakeholders on requirements, making sure there is consistent satisfaction with how requirements are stated. This means negotiation at a technical and organisational level, involving the right people at the right time, asking the questions of what, who and how at this stage of the process [25].

Our results showed that Cloud professionals demonstrated several key practices that were used in parts of Requirement negotiation. Testing and its use was previously cited in interviews with Cloud professionals, with P4 stating the following regarding the use of AB Testing:

> "They give various feedback. They say that, OK, it's not feasible in here. It's not OK in here. I got stuck in here multiple times and I said OK in a room of 100 people that we tested this out, 95 gave a really positive feedback. Five of them found this one. I think that's a great score to go. So let's start implementing."

While AB testing itself appears in the latter stages of development, P4 states how direct user feedback shaped the way in which a product may go, giving stakeholders a perspective of how their requirements were perceived by intended customers. While it was not clearly mentioned, a link between Requirements negotiation and AB testing within Cloud is apparent, allowing for teams to be able to negotiate Requirements with direct customer feedback as well as proving the performance of several key features.

Another commonly referenced process in support of Requirements negotiation was Agile and specifically the ability for tasks to be adjusted during development. P5 stated the following:

> "I would say multiple meetings, so we will get these requirements in a planning phase of the Sprint. Then we will discuss them if we are not clear with the requirements, we will need another planned meeting with maybe the devs, maybe the product owner. " - P5

This implies that there are several instances where discussions were held to negotiate requirements with the Agile team, only involving further, more experienced members if there is a general lack of understanding. Further elaborating on this aspect of Agile and discussion during development, P3 stated the following:

> "I said, once in two weeks, we have a Sprint planning where we gather with a specific team and we decide, we talk about what has been implemented, what needs to be implemented and maybe what something has gone wrong in the implementation. " - P3

The agility the teams have allows them to sit down with another, questioning what needs to be done and how it needs to be done. The interviews all showed the importance placed by interviewees on discussing requirements as well as needing to hold stakeholder discussions to clarify requirements. This further reflects the testimonies of each participant who discussed Agile and needing to communicate requirements after their inception or attachment to a project.

Negotiation of requirements within Automotive was talked about very briefly by our interviewees, albeit echoing previous remarks and restating established points. However, their insights still show some practices that are used in Requirements negotiation within Automotive. Upon asking P7 about how key constraints were identified, they presented the following point about Requirement re-use as well as questioning established practices:

> "Inherited requirements from older generations of the product or from older projects that don't make sense anymore, but you do still need to look into them, and, and prove that they really don't make sense anymore. - P7

Although the participant did not clearly state the practice used, they did however mention the inherent use of Agile and the practices used within this framework. The results therefore raise the possibility that this process is part of their Agile processes, either being a part of Spring meeting or/and being a part of Sprint planning and the former processes of Requirements Engineering. Stakeholder discussions made a re-appearance in Automotive, with them being one of the only practices we found that directly links to Requirements negotiation. P8 stated the following:

> "...there are meetings at the start with the stakeholders, then it's not that much official those requirements. You talk with them, with suppliers, with your colleagues, with your teammates and then there might be a need for testing for example" - P8

This brought up the sub-theme "Communicating Requirements" under "Requirements Engineering Processes", as both Automotive and Cloud professionals were under the shared understanding of the importance Stakeholder communication.

Another point made by P8, which is also very prevalent and important for how Automotive functions is prototyping. P8 emphasised the ability to "do iteration after prototyping" in order "to understand the weaknesses of that specific technology, and then specify the requirements." This suggests that prototyping was a means of identifying weaknesses in the design of it as well as its technologies. In practice, this technique reflected how requirements were negotiated after an iteration of a prototype. P8 reflected on this idea by saying that if there were "some doubts on necessary aspects of the system that you can test it on your prototype" in order to meet requirement fulfillment. The prototype itself is what becomes the discussion for Requirements negotiation and allows for proper deliberation with stakeholder and developers alike, becoming catalyst for iteration cycles.

F. The Importance of Trade-offs and Prioritisation

Below, the structure is as follows: discuss how and why prioritisation occurred in both Cloud and Automotive and the key trade-offs within this prioritisation.

Maintaining data integrity, ensuring service availability, and managing variable loads effectively, are the characteristics that define the Cloud computing industry. After interviewing professionals within the Cloud domain, we could clearly see that the prioritisation of requirements are related to Security, Scalability, and Adaptability. For instance, one of the participants stated the following:

> "The first thing is security, that's for sure, because security comes with availability and comes with resilience and the data, the consistency of data" - P2

The participant underscores the importance of security, especially with applications exposed to the internet. He further emphasises on Security being the priority when working with Cloud and the requirements, by saying that operating in vulnerable environments such as the internet, security measures are not negotiable and must be implemented carefully to ensure data integrity, service availability, and overall system resilience.

However, as Security was the main key aspect that we noticed throughout the interviews, we saw several approaches to prioritisation done by professionals in the Cloud domain. Depending on the organisational hierarchy, we found that the prioritisation varies and we can therefore assume that participants working as Tech lead or managers have a different perspective of the project and company's objectives. One key criteria for prioritisation for Security was stated by P5:

> "It is prioritized based on the urgency, the value it brings to the application" - P5

Other participants from the Cloud domain stressed that requirements should be prioritised by importance, blocker tasks, and urgency. This was reverberated by professionals from the Automotive domain, who highlighted similar answers; however, Automotive domain focuses lay in the Safety, as a key aspect, when prioritising requirements instead of Security. One of the participants from the Automotive domain stated the following:

> "The hardware requirements normally have more priority because [...] you cannot update your hardware when the car is outside, but you can always update the software." - P8

This indicates that hardware by nature is very rigid and predefined, so Automotive experts need to align themselves with these constraints prioritising them over any subsystems or software collaborating with them. However, one unanticipated result was that one of the participants from the Automotive domain highlighted the lack of prioritisation by saying the following:

> "It was more of a checklist rather than priority but I was never really involved in that. [...] I don't even know if there was a priority. I don't know if there is a officially priority." - P7

This is an informal approach to handle the requirements and it shows that the approach implemented in their current company lacks some sort of prioritisation. However, when we further investigated if the approach was indeed that simple or minimal, P7 stated the following:

> "Maybe the customer says we need this ASAP [...] Usually the product owner would mark or tag some things that were relevant to our team" - P7

The prioritisation structure may have been organised on a higher level without the participant paying attention to it. One reason for that could be the lack of knowledge from the participant or prioritisation on a more developer-independent platform which hands down preorganised requirements to developers. Both of which are possibilities for the company that P7 worked for; however, further details were not discussed.

Trade-offs were a key factor in the type of prioritisation that occurred in responses from Cloud practitioners, echoing a similar quality attribute that is above others. Security was the overwhelming response to any questions relating to constraints they had and what things they had to prioritise when developing Cloud-based applications. P4 stated the following when asked ranking requirements:

> "So we need to prioritize security, in some cases, over feasibility of the client and we have to do a trade for security and offer less options to the client." - P4

Another interview stated a similar sentiment regarding the alignment with Security and the trade-off associated with prioritising security:

> "If it's something that will, is exposed on the Internet, the security requirements should be met without any exception or something, this is critical. [...] because sometimes some security requirements decrease the performance or decrease operation of this application and so you have to to prioritize which one is much more important" - P2

As well as stating this about quality attributes of the system:

> "But, but security is also a very important topic, and based on the environment of course can be like a top highest priority more than develop because it affects our availability. " - P2

The alignment with Security reflects that Cloud applications run externally and are hosted by other companies and are accessed by a plethora of users. Therein we can see that trade-offs made to ensure Security allow their systems to function without intrusion, albeit at the cost of other quality attributes such as Performance or Usability. This was an inflexion point on which we noted the theme ***"Importance of Cloud Engineering for Modern Development"*** wherein we saw that Cloud engineers as well as more often Automotive engineers cited the importance placed upon Cloud engineering for their solutions. They stressed how scalable these solutions were and their impact on their work.

Within interviews of Automotive, key trade-offs were discussed shortly, emphasizing the key aspect of Safety, which is synonymous with the Automotive industry. Trade-offs brought up the theme of ***"Limitations of Industry Domain"*** wherein it was emphasized that sacrifices were made based on the domains objectives and their challenges. One perspective which was briefly mentioned was the idea of new versus old hardware, wherein P8 said the following:

> "It's always a trade-off. If it's a new technology, then the then limitations are unknown. If it's old technology, then maybe it has less performance than the new technology, so it's always a trade-off between these two. And then the it's basically expert judgment: Which one can be used?" - P8

This statement refers to the idea that new technologies have known unknowns that need research and testing which may not be as fleshed out as for older technologies. This key fact rules out the possibility for integrating something that may impact the Safety of a vehicle. This was touched upon again by P8:

> "Any failure in a vehicle would lead immediately to some kind of accident or life threatening aspect" - P8

This Safety first approach is necessary as P8 later goes on to describe how testing something out in the Cloud results does not have as big impact as a single failure in the Automotive domain can lead to. This further emphasised the theme ***"Importance of Cloud Engineering for Modern Development"*** as P8 and the other Automotive who shifted toward the idea of how Cloud offloads some of the car's responsibilities and offers greater flexibility in development.

The uncompromisable stance of Safety aligns itself with the idea that new technologies take longer to adopt into existing frameworks and systems that require all the detail and care that goes into ensuring absolute safety for customers. P8 reflects how development is prioritised in Automotive, despite the allure of innovation:

> "There are different ways to prioritize the implementation but to me the safety and cyber security aspects, at least in our field, has the most priority." - P8

The focus is on Safety and anything that may compromise it, even if it compromises Performance or Efficiency. From these responses, we see the importance place on prioritisation leading us to draft a sub-theme to ***"Requirements Engineering Processes"*** titled ***"Importance of Prioritisation"*** which reflects that participants remained firm on their stance that prioritisation remains a crucial factor for their RE process.

G. *Effect of new Technology on RE*

The following section will follow the order of explaining testimonies of the effect of new technology, their effect on the RE process and finally how both domains account for the effect that new technology has on RE.

Large-Language-Models (LLMs), ML, Artificial Intelligence (AI) among others, are emerging technologies that the participant were asked about in relation to their effect on current RE practices. The feelings regarding these new technologies were mixed; however, most of the participant had an positive stand regarding the impact of new technologies. Starting with the Cloud domain, the results showed that their interest lays in technologies that benefits the automation process. P4 stated the following which clearly indicates the interest of new technology which has already been adopted:

> "[My team is] writing utilities that otherwise would consume a lot of their time, which really are not that much of important to the process. So any side task [...] they basically just outsource it to ML models now, and see what we can do." - P4

P5 later went on to say the following regarding the impact of working side-by-side with new technologies:

> "I don't think the AI will be able to fully replace humans. So personally, I think these tools are more profitable than a threat" - P5

The participant highlighted that emerging technologies such as AI will be used as a tool to automate processes; however, P5 further elaborates on the question regarding the effects of emerging technologies within the Cloud domain, by saying the following:

> "new technologies will also come with certain risks and costs that we need to take into account that new technologies will be costly will be pricey. - P5

This showed that new technologies are not always beneficial for the industries, and caution should be employed considering the potential financial impact. P3 had a positive view regarding new technologies, believing that "people should stay updated on the latest trends and understanding how they impact what the user wants.” P3 further stated that new technologies are helpful and will make the work more efficient and effective citing that he believes that technologies “are really helpful in the long term of working” and that “it’s just gonna make the work easier”. The theme ***“Perceived Impact of New Technology”*** was conceptualized after these remarks, emphasizing the frequency and importance place on how new technology effects their RE practices for better or for worse.

While new technology is something that all interviews highlighted, their effect on RE was mentioned by few. Our results showed how Cloud professionals highlighted the potential impact that new technology can have on RE practices.

> “I think the impact will be good. So the shift of or the adapt of a new requirements, new rules, new management I think would be a good thing... but also needs more training, it will also need more time to be fully adaptive in our current work environment. So yes, I think introducing new technologies or new processes or requirement processes will be a good impact on the future work quality” - P5

> “So there is this mixed environment with maybe new and nice technology somehow makes it so difficult on managing and on the resourcing, on perspective on people perspective because you need experts from different services” - P1

P1 and P5 illustrate that there are or will be changes in the workplace today, however, they highlight that new technologies require more training and integration into current environments. P3 believes that “new technologies, of course, are big help and now I believe we are the, in the time of ChatGPT, which is not always such a good solution”. With this contrary view, they offer a middle ground in saying that “it’s like adding a new tool in a toolbox” meaning that new technologies might not always be the right solution but are always good to have when needed.

While the idea of a new tool says little about which aspects of RE are affected, it may be indicative of a wide spread adoption of technologies such as ChatGPT for use in the entire process of RE. This idea of adoption is further stated by P5 in relation to how new technologies cause this idea that RE must adapt to stay up to date with these technologies:

> “I have seen new technologies being implemented, so the need for new technologies is always there: it’s always growing and I would say the also the requirements engineering will shift or not “change”, maybe “evolve” to adapt to this new changes and expand for these new technologies. The need of new technologies will come with the need for new changes in requirements.” - P5

Cloud practitioners, however, show interest to test new technologies in existing processes, with one participant stating that new technologies plays a role within current RE and development processes. The theme ***“Perceived Impact of New Technology”*** is further reflected in statements made by P5 where they describe that their team already has tested using Chat GPT in their process reaping the benefits that it brings. The results from Cloud practitioners show us how new technology will have an effect on RE; however, to our dismay, there was no clear indication of what that effect or where that effect would be.

Our results show an era of concern or caution for Automotive practitioners, echoing some of the notions posed by Cloud practitioners in that new technology affects RE practices; however, they highlight some skepticism around the true effect that it may have. When asked about new technology and its effect on RE process, P7 said this:

> “I mean, the more technology advances, the better systems become. The new requirements are generative. I think the process, the process, the requirements will be affected, but the process itself, if that’s what you asked will kind of remain the same or it will not fundamentally change” - P7

With P8 discussing the ramifications that new technology might have on RE and that the shift is not as easy as just implementing new technology into ongoing practices. They stated that agreeing on requirements and specifying them in the right way both take more effort and time than usual. Moreover, they show understanding that knowing the limitations of the technology is required to understand what types of requirements will be created.

This indicates that, while requirements and technologies shift to match the demand, the core processes of RE will not change. P7 echoed the nature of Automotive stating that something is “usually not affected once something is in production, you usually don’t get affected by new things coming in” which indicates the negligible effects new technologies have on ongoing development. Specifically, in reference to what new technologies could have an effect on RE processes, Automotive practitioners were similarly skeptical but remained persistent that there will be an effect. P7 offered a perspective on LLMs role in Automotive RE practices:

> “To my knowledge, the process of requirements engineering hasn’t really spectacularly changed over the decade, maybe LLMs might affect that but that’s on, not so much [INAUDIBLE] test cases or test plans to make, make our life easier or maybe explain things or maybe try to automatically figure out OK this requirement is not valid anymore” - P7

The current RE processes and practices are so well established in Automotive that it seems that new technologies will likely be used a auxiliary tools to aid in the existing process rather than changing the way in which this process happens. However, while these results showed the potential new technology has, P6 stated how company regulations and NDA agreements disallowed them from using new technologies within any part of their work. The theme ***"Limitations of Industry Domain"*** resurfaced here as we saw that Automotive experts echoed Cloud practitioners in their understanding that they way their domain is going, there is a slight deviation from the planned rate of adoption. Therefore its safe to say that Automotive practitioners are optimistic but cautious in how these new technologies are usable within their well-established RE process, as well as being limited by legislation and privacy concerns that these new technologies may possess. The statement helped us establish the theme ***"Regulatory Constraints in development"*** and show how these regulations inhibit the methods for development and framework for both domains as well as the theme ***"Limitations of Industry Domain"*** coming up to reflect that Automotive and Cloud have unique challenges within RE that are not entirely solvable by new technology.

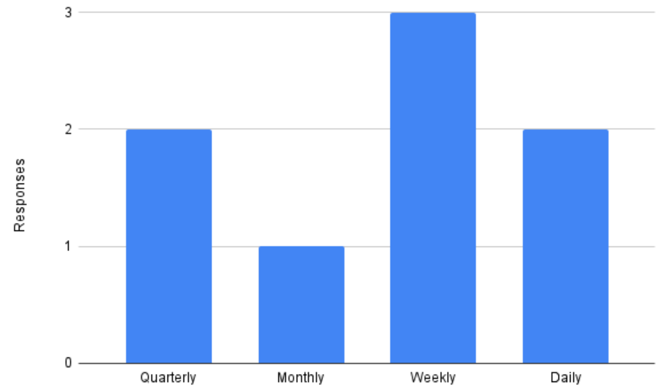
V. Survey Results

This section presents the themes, see Table IV in the beginning of the interview results, that emerged during the analysis of the interviews' transcriptions and displays their agreement based on the survey results.

Every interviewee mentioned the importance of stakeholders and their role in RE. Several key practices were inter-team communication in Scrum and stakeholder discussions, both used to communicate, negotiate and further elaborate requirements. This links to one of the sub-themes of the theme ***"Requirements Engineering Processes"***, titled ***"Communicating Requirements"***. Based on this sub-theme, we asked all interviewees in a survey to elaborate on stakeholder discussions and how frequently they revisited Requirement prioritisation to stay in line with stakeholder needs. Figure 3, shows that, despite different workflows, experience and corporate structure, requirements were revisited mainly on a weekly basis, with several interviewees reflecting on Daily and Quarterly iteration as well. This constant dialogue with stakeholders implies a consistent communication line, allowing development of requirements to remain consistent with stakeholder needs and in line with what needs to be prioritised. Figure 8 in the appendix, confirms both the themes as well as the sub-theme of ***"Verification and Validation testing"*** showing that participants spoke with Stakeholders as their main method for Requirement Validation. This shows that stakeholders were central to all parts of the RE process in both Cloud and Automotive.

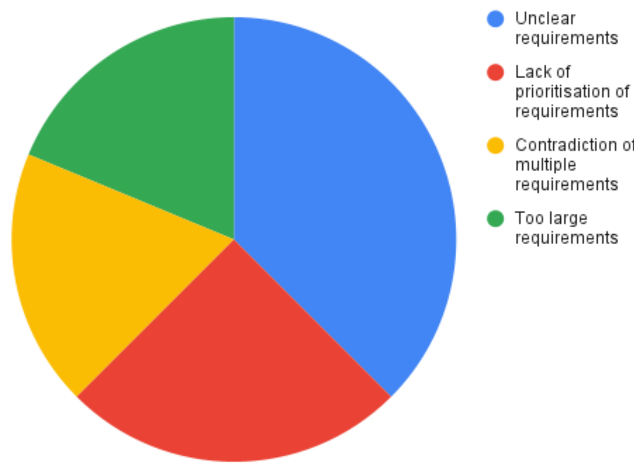
The theme of ***"Established Industry practices for development"*** was embedded within every interview, as participants discussed how their companies deal with requirements and develop accordingly. This theme had sub-themes that reflected the benefits and drawbacks of these established practices This lead us to ask interviewees in our survey about which

Fig. 3. Frequency of Requirements revisiting to match stakeholder needs



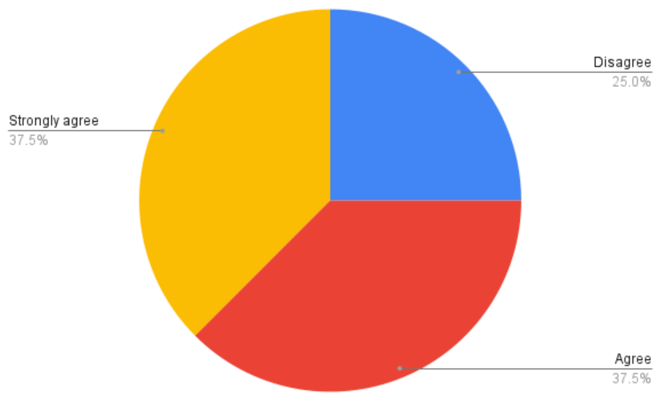
drawbacks they identified on RE practices used in industry. The results in Figure 4 show overwhelmingly that **unclear requirements were the biggest drawbacks** identified by interviewees, confirming certain results from [12] who cited similar issues caused my lacking requirements. This is an indication that **several key RE practices within both Cloud and Automotive are either done not correctly or the lack of RE professionals is apparent**.

Fig. 4. Perceived Drawbacks with RE practices at place of employment



Within this discussing the necessity of these key aspects in requirement prioritisation, most highlighted the importance placed upon Cloud based services. P2 states how Cloud based operations identify that "security requirements decrease the performance or decrease the operation of an application" reflecting that they "prioritise which is much more important" when there is direct exposure to thousands of users. Even those within Automotive, discussed similar conclusions, citing a general migration to Cloud based services as well. Due to this we found that the theme ***"Importance of Cloud Engineering for Modern Development"*** precisely echoed what interviewees highlighted. To confirm this theme, we asked the question if interviewees agreed with this theme and that it was reflected at the company they work in. Figure 5 shows that 75% of interviewees strongly agree or agree with this theme, reflecting a general trend that both domains are placing an increasing importance on Cloud for future products/projects.

Fig. 5. Percentage Agreement on theme Importance of Cloud Engineering for Modern development being reflected in Workplace

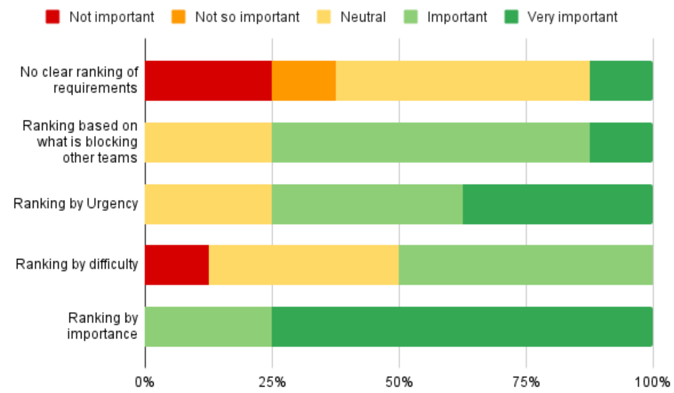


The theme of ***"Regulatory constraints in development"*** came up again, showing that requirement re-use was done for convenience, saving time and money and most importantly still following ISO standards. Figure 9 within the appendix reflects the agreement of this theme and how frequently these constraints appeared within development. Several criteria supported this aspect of Safety, some which reflected what Cloud practitioners also stated, albeit with different a different goal and purpose. Gathering constraints was something that was discussed by Automotive practitioners, which revolved around **identifying hardware limitations, software and hardware interactions, and overall system performance**.

Among the several criteria that was similar between both domains, we asked all interviewees the question of which prioritisation method best matched the company's way of ensuring their key aspects. Figure 6 shows, in order, that Ranking by importance was the most important for all interviewees, with ranking by urgency and ranking based on what was blocking other teams following in that order. Both no ranking of requirements and ranking by difficulty were not methods that were seen as important for most interviewees, showing that both Cloud and Automotive have similar approaches and needs in how they want to achieve key aspects such as Safety or Security.

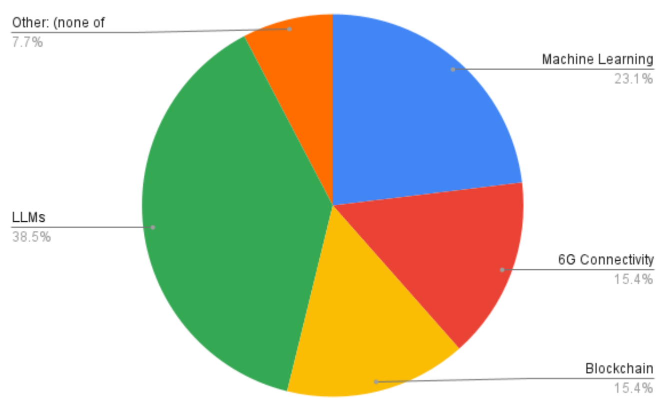
We asked interviewees which technologies posed a risk for how requirements are managed and worked on. Figure 7 shows that **all interviewees agreed that LLMs pose the greatest risk** with ML a close runner up, showing clearly that between RE methods or techniques and LLMs/ML there exists a gap, which reflects conclusions from [21]. Due to this constant reiteration of the effect that technology will have, the theme ***"Perceived Impact of new technology"*** was reflected on, both good and bad impacts of these new technology on their work and RE processes. However, Figure 11 in the appendix shows that technologies can also elicit improvement in the RE

Fig. 6. Ranking of Prioritisation Methods based on Importance for Company



process, namely with Automation and GPT tools to accelerate workflows for both domains.

Fig. 7. Consensus on technology that poses risk to how Requirements are managed and worked on



VI. Discussion

The following section discussed the research questions and further analyses the contribution that our study has on V2C development. Moreover, this section reflects on the validity of our findings.

A. Current Requirement Engineering practices (RQ1)

From our results, we have identified several key practices for RE in both Cloud and Automotive, reflected in the many testimonies that our interviewees gave us. The general consensus was that Agile was the main development methodology for both Automotive and Cloud. This is an indicator that both Cloud and Automotive follow Agile principles and therefore work in an iterative manner. With the help of Agile, RE has a platform on which key decisions on requirements are made as well as facilitating the different stages of RE. Within the RE process, there are several key practices that were mentioned by participants, all of which were done in combination with common Agile practices.

Re-use of requirements was something that interviewees for both Automotive and Cloud stated when discussing how project were conceptualized. This finding was unexpected as we initially thought that **between Automotive and Cloud, Automotive is the domain that most often re-uses requirements**, falling inline with [17, 19] and that Cloud remains rather dynamic, often sourcing new requirements from aforementioned PoCs or Prototypes. Cloud cited that time efficiency was a key reason for re-using requirements. Additionally P1 stated that re-use of similar architecture to not only benefit in having standardisation but to improve time to market and not having to "re-invent the wheel every time". In contradiction to [13] and [14] who presented how requirements in Cloud are consistently shifting, our findings show that requirements are re-used and static when a new product with similar features, architecture, or requirements is being conceptualised. This implies that there is a similar re-use of requirements in both Automotive and Cloud, **prioritising re-use to save time and money in development** as well as making sure that new systems adhere to existing standards and regulations.

Proof of Concept (PoC) and Prototyping were both methods employed by Cloud and Automotive to understand and conceptualize projects and requirements which both were previously unknown or undiscovered. Cloud practitioners, however, focused more on these aspects within their RE process, as our results showed that it was easier for them to provision these PoCs given the availability of Cloud environments on which they could test projects on. In contrast, Automotive prototypes were based on physical hardware and thus acted as tools to further identify requirements and understand strengths and weaknesses of previous requirements and designs. This is further used as proof for stakeholders that certain requirements are still valid or if more research needs to be done. The differing development environments of Automotive and Cloud show that prototypes or PoCs directly relate to the project being completed and the intended purpose of the prototype, whether to understand technological constraints or prove feasibility to stakeholders.

Within Cloud and not Automotive, one of the key practices which came before the RE process was investigating financial feasibility when provisioning new projects. This was important to mention as this practice belongs to the *Feasibility Study* which is a core element that influences the subsequent RE process. **Results showed that Cloud practitioners depended on the financial aspect of their project as a success criteria**. As Cloud practitioners all stated the use of external Cloud providers, this shows another aspect of where project requirements were drawn from. This indicates that without financial feasibility translating to requirements, there is an inability to measure the maintainability of a project in the long term [26].

B. Key aspects in Prioritisation (RQ2)

Our results yielded several key aspects for both Cloud and Automotive, reflecting similar findings in the literature. There was a pattern in the criteria which supports prioritising key aspects found in results. We found, however, that the key aspects were different between both domains. For Cloud, practitioners mentioned Security, Scalability, Adaptability and in some few cases Availability as their key aspects. Several interviewees mentioned that Security is prioritised over other aspects, discussing how key trade-offs were made to ensure that **Security remains the most important, despite the detriment to other factors impacting the project such as performance or usability**.

These key aspects were the foundation for any Cloud project, but to achieve these key aspects, certain criteria was used to break down the key aspects and ensure that requirements mirrored the perspective and goals that these aspect posed. Interviewees reflected mainly on the urgency and value of requirements as key indicators for which requirements to implement first. Results showed that these criteria directly came from key aspects, most of all from a Security standpoint, confirming previous discussions. This comes unsurprisingly as **any potential security threat or risk needs to be fixed and deployed as urgently as possible within a Cloud setting**. The value of requirements directly relates to their ability to satisfy the other key aspects, maintaining the frequently mentioned DevOps principles of deploying quickly to live services. The same can be said for the reflections on the role of importance and ranking requirements based on what stakeholders deemed necessary for development within iterative development cycles.

Expectedly, the key aspect that Automotive highlighted was Safety. This aspect was frequently reflected on, even in combination with highlighting the importance of why Safety is paramount to Automotive applications. One of the participants highlighted the importance of Safety through testing. They mentioned how a failure in Cloud, has negligible effects on customers, other than some downtime in their application. However, in Automotive, the effect of a single failure can result in the bodily harm of one of more persons and potentially ruin the entire brand image. Therefore, Automotive is required to have more strict guidelines which they have to follow in regard to fulfill these Safety criteria. These guidelines were mentioned by two separate interviewees, discussing ISO 26262 and how strictly **their requirements had to face the scrutiny of a plethora of ISO standards**, directly tying back to investigations by [9]. We found that a reason for requirements re-use was due to these pre-existing requirements already satisfying ISO standards, which make sure that the key aspect Safety is prioritised. This showed a stagnation in new requirement generation in favour of established requirements, reflecting results on how regulations kept interviewees from innovating.

C. Role of Future Technologies in RE (RQ3)

The last interview questions sought to get an understanding of where Cloud and Automotive thought new technologies were heading; whether they perceived these new technologies as a threat to existing RE practices or how these technologies generally impacted development as a whole. Overwhelmingly, professionals on both sides, argued for the **integration of new technologies such as LLMs, Automation, GPT-tools and ML**. They cited how new technologies would certainly bring new requirements indicating a possible shift in the type of requirements, rather than an change in the RE process. Several interviewees mentioned this, rejecting the effects that new tech may have on the RE process itself in favour of being intrigued by the possibility for different and new types of requirements posed by technologies such as, for example, LLMs.

In terms of how new technologies affect RE practices, the responses from Cloud and Automotive professionals varied. Cloud professionals cited how new technologies could speed up their tasks and improve their RE process entirely. Their perception of these new technologies was more positive in its affects on RE and their development process; however, most stated that **these new technologies will require money, time and education to fully understand and introduce into the work settings**. These drawbacks were cited as the main reasons why most technologies had not been fully adapted highlighting the fact that the companies of the interviewees are more reluctant than we initially thought. Our interpretation lies in that current RE practices are susceptible to change by these new technologies but are not currently being changed, implying that in Cloud companies' RE processes and practices are not as adaptable to these new technologies at the moment.

Within Automotive, we see similar caution regarding the integration of ML, LLMs, Automation, etc. within RE processes. Interviewees pointed out that existing processes will remain the same, in that **new technologies will not disrupt core functions within the RE process but will only assist or enhance certain aspects of it**. We saw that generally in Automotive, these new technologies will have a diminishing effect on these well-established RE processes, requiring more of disruption to change their process using these new technologies. In terms of adaptability, this also shows that Automotive RE practices are stable and that the effect of new technologies has diminishing returns for the RE process as a whole. P7 stated that "the more technology advance, the better systems become" making sure to mention that technologies do improve and affect requirements, but that "the process itself" will "remain the same or it will not fundamentally change".

D. The Future of V2C development

To tie our research back to the initial object of bridging the gap between Automotive and Cloud for V2C development, we found that both Automotive and Cloud use similar practices and generally have a similar approach to RE. However, **the domain's main objective and key aspects for which requirements are prioritised are fundamentally different**. This clear distinction makes unifying these two domains incredibly difficult, as one prioritises Safety and a long project life-cycles while the other prioritises Security and quicker deployment of systems. These fundamental differences make it difficult to unify as there are trade-offs that each side would have to make in order to use a single RE process together when creating a V2C product. These trade-offs are a major factor in why the unification of RE processes of Automotive and Cloud are inherently difficult to achieve, as neither side would concede on their stances on Security or Safety.

E. Threats to Validity

a) Internal Validity Threats: One threat was not informing interview subjects about the study and what we do as well as not providing information on how we use and collect data. To mitigate this, all participants for the interview were informed of the nature of the study, the information we aim to collect, consent forms, and lastly any supplementary information regarding the topic itself. To address the threat of an infeasible study protocol or weak interview questions, we conducted a pilot interview with one interviewee after which the questions were refined before data collection occurred. The interviewee received their recording and transcription, so that any mistakes or miscommunication were cleared up after the interviews occurred. To mitigate the risk of low reliability of our codes and a low inter-coder reliability, the use of multiple coding rounds discussions ensured an understanding of the chosen codes and their assignments. Similar practices were done for the follow up surveys as they collected qualitative data as well, using pilot surveys and coding rounds with discussions. To ensure that qualitative coding was as unbiased as possible, we did rounds of coding with discussions after each to ensure that we understand the chosen codes and their assignments.

b) Construct Validity Threats: One of the threats was being unprepared or unknowledgeable for the interview which could lead to poor followup questions. To mitigate this, we brought sufficient domain knowledge to answer any domain specific questions should they arise during the interview as well as prepare in advance any relevant studies for each of the questions to supplement insights we present. As mentioned in internal validity threats, the interview guide was improved after the pilot interview although a threat could have been posed by the limitation of a small number of interview which leads to having only one pilot interview. This threat is increased by not being able to iterate the interview guide over several pilot interviews before data collection. In an effort to mitigate confirmation bias on questions asked, both authors who were present in the interviews, took turns asking questions. One threat is the use of Percentage agreement which does not account for random assignment of codes. While this threat was not resolved in our research, the thorough documentation of our method and the ICR table displayed how we demonstrated the overall agreement on codes generated.

c) External Validity Threats: A threat to our external validity was the amount of people we planned to interview and the varying levels of expertise, exposure to the subject and domain knowledge that they bring to the table. As we did not have enough time and required individuals with knowledge to some degree, we also did not use random sampling rather used convenience sampling for the interview. Given the sampling technique illustrated, we were unable to mitigate this threat as we did not have a clear choice of who to interview and what criteria they needed to fulfill in order to qualify for our study. The choice of a Mixed method study with five companies of varying location and products may have lead to a variety of reflections on different, unrelated topics. This limitation was mitigated by stating a more concise and detailed context for the case study as well having more detailed questions and follow up questions to achieve saturation on research questions without receiving unrelated company information.

VII. Conclusion

In our study, we asked ourselves if there was a possibility that Cloud and Automotive RE practices can be unified in the development of a V2C system. In this endeavour we conducted a Mixed Method study, involving eight interviews, and one pilot interview, from five different companies. This was done to get first hand accounts of what RE practices were done during their RE process, how prioritisation of requirements occurred and to see how future technologies will impact the RE process. Within our Mixed Method study we conducted interviews, followed up by Thematic Analysis, to generate Themes for our confirmatory follow-up survey.

Our results showed that RE practices varied between Cloud and Automotive companies, but remained similar in the way key practices of the RE process were conducted. Some key findings showed the emphasis Cloud practitioners put on proving Financial Feasibility for project, and the role of finances prior to the RE process. Both Cloud and Automotive discussed the role of Prototypes and PoC when eliciting new requirements, citing how it can expose constraints or disprove pre-existing requirements. Stakeholders played a large role in all parts of RE, highlighting the importance of practices such as stakeholder discussions in gathering, negotiating and prioritising requirements.

On the topic of prioritisation, we found that Cloud and Automotive had different agendas regarding key aspects such as Safety and Security. Unsurprisingly, these key aspects dictated how requirements were generally prioritised, with some cases even influencing the way in which requirements were elicited. This tied back to our introduction, confirming our initial theory about how the priorities of the domain impact the way in which RE practices are conducted.

Our findings for RQ3, presented that new technologies are interesting to both domains; however, they agreed that new technologies require time, money, and resources to be implemented within RE practices. This shows that resilience and robustness were the general perception when discussing current RE processes showing an unwillingness to change rather than an inability to.

In summary, our study exposed certain RE practices being conducted within Cloud and Automotive companies. Furthermore, we highlighted the fundamental aspect of Safety versus Security in prioritisation, reflecting on the difference in prioritisation for Cloud and Automotive based on key aspects as stated previously. Finally, we presented the general consensus on how new technologies may affect ongoing RE practices and a positive interest in these technologies, but a firm stand against using them to alter or change their RE process.

A. Future Research

In a future study, it would be best to interview more participants from both Cloud and Automotive, being more selective who and what experience with RE they have. This would allow for a more profound collection of data and testimonies which would surely grant more information regarding our research questions. With regards to V2C, it would be interesting to conduct the a Case Study with a larger V2C company to see how they manage the differing requirements, key aspects and alignment of resources for their Automotive and Cloud components. In regards to new technology, a study should be conducting to see the effects of new technologies in existing RE frameworks, comparing the quality and effectiveness of requirements between adjusted teams and existing teams. Some topics that we found needed more investigation were:

- The difference in Safety and Security requirements within Cloud and Automotive projects
- The impact of LLMs on requirements generation within Automotive and Cloud based projects
- Seeing what exact impact new technologies have on current RE practices within Agile teams
- Further identify the theme “Role of tools and methods for RE and development”
- Conduct a in-depth analysis or interview study detailing the “Limitations of industry domain” and how it holds back Cloud and Automotive collaboration on a large scale
- Conduct a larger interview study with a V2C, using Cohen’s Kappa score to achieve ICR, in order to get insights for the same research questions albeit in regards to V2C

Taken together, this study has shed light on the future for V2C development, for which the interest and demand is steadily increasing. Further work in standardising the RE practices between the Cloud and Automotive domains and in addressing the gap exposed in this study, will be needed to achieve a broader use of V2C in our society.

Acknowledgment

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Appendix

Fig. 8. Requirement Validation Techniques

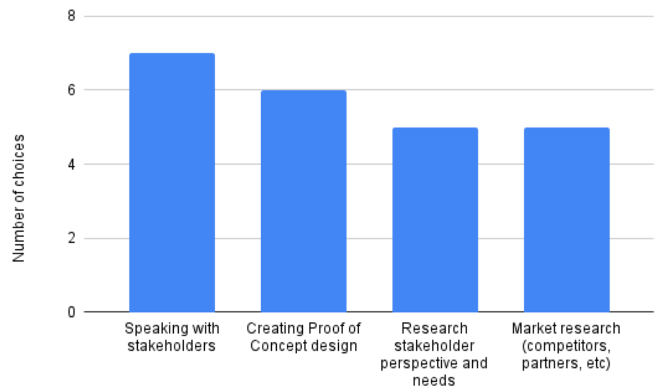

Fig. 9. Consensus on how frequently Regulatory Constraints hampered or inhibited development

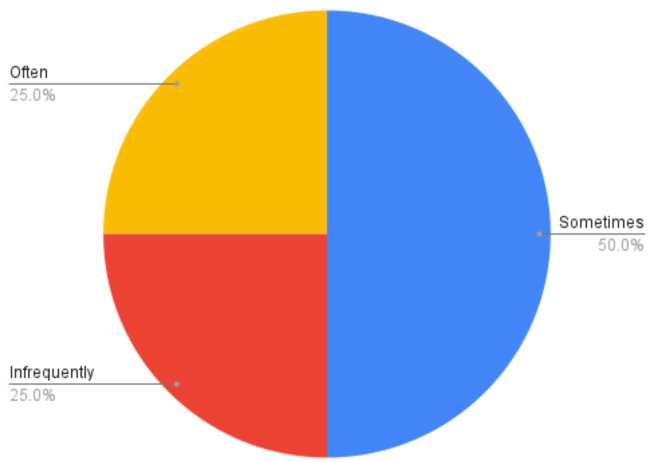

Fig. 10. Percentage agreement of theme of Limitations of the Industry Domain

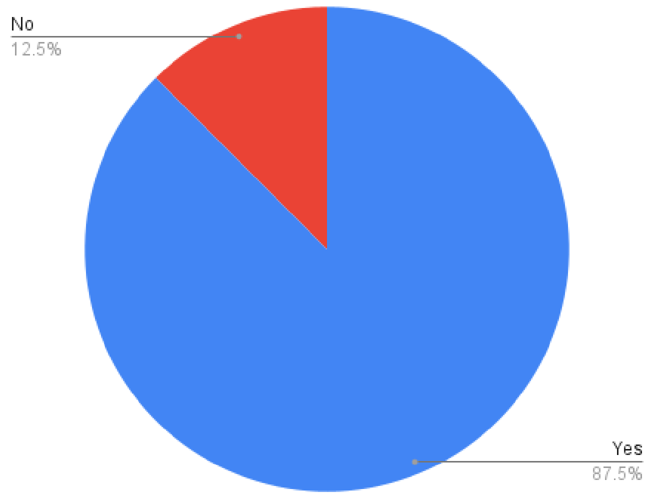

Fig. 11. Consensus of technologies for improving Requirements Engineering and Requirements

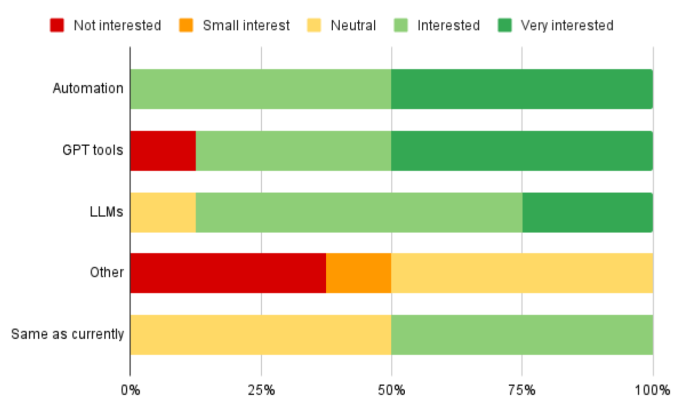

TABLE V
SURVEY QUESTIONS

Theme ID	Interview Questions	Question Type
NA	1. What is your overall experience with software development? 2. What is your job title within your company? 3. In your opinion, how much do you know about Requirements Engineering 4. What is the size of the company you are employed at? 4.1 Micro (<10) 4.2 Small (<100) 4.3 Medium (<1,000) 4.4 Large (>1,000)	Short answer Short Answer Likert Multiple Choice
5., 5.1	5. Select some of the perceived drawbacks, if any, with Requirements Engineering Practices employed at your place of work? 5.1 Unclear Requirements 5.2 Lack of prioritisation of requirements 5.3 Contradiction of multiple requirements 5.4 Too large requirements 5.5 Other (with text box)	Multiple Choice
7., 7.3	6. Choose all of the ways requirements are validated according to the ways in which your company operates 6.1 Speaking with stakeholders 6.2 Creating Proof of Concept design 6.3 Research stakeholder perspective and needs 6.4 Market research (competitors, partners, etc) 6.5 Other (with text box)	Multiple Choice
4.	7. Do you agree with the following theme of "Limitations of the Industry Domain" in regards to difficulty to innovate, difficulty to establish new technologies or standards, etc?	Polar Question
1.	8. How often would you say that Regulatory Constraints hamper or inhibit development when working on existing or new features? 8.1 Rarely 8.2 Infrequently 8.3 Sometimes 8.4 Often 8.5 Always	Multiple Choice
7., 7.1	9. How often do you iterate over the requirements to ensure that their prioritisation is still up to date with stakeholder needs? 9.1 Daily 9.2 Weekly 9.3 Monthly 9.4 Quarterly	Multiple Choice
7., 7.2	10. Based on the following Ranking methods for Requirements, which methods are more important within your organisation? 10.1 Ranking by difficulty 10.2 Ranking by importance 10.3 Ranking based on what is blocking other teams 10.4 Ranking by Urgency 10.5 No clear ranking of requirements	Likert Scale
3.	11. Do you agree that the theme "Role of tools and methods in RE and development" reflects the way in which your company often conceptalizes, agrees on, and manages requirements?	Polar Question
2.	12. Do you agree that the Importance of Cloud Engineering for Moder development is emphasized in your current work?	Likert Scale
6.	13. Which of these technologies pose a risk to how current Requiremets are managed and worked on? 13.1 Machine Learning 13.2 6G Connectivity 13.3 Blockchain 13.4 LLMs 13.5 Other (with text box)	Multiple Choice
3., 6.	14. Could you describe how these technologies might affect the adaptability of certain systems or even teams in regards to development and requirements engineering?	Long Answer
6.	15. Which technologies would you personally use for improving Requirements Engineering as well as the way Requirements are managed? 15.1 Same as curretly 15.2 LLMs 15.3 Automation 15.4 GPT tools 15.5 Other	Likert Scale
NA	16. If you put "other" above, please state what it is below:	Short Answer