**Paper reading sheet**

1. **Bibliographic data**
2. Title, authors, year, publication.

The research paper described in this reading sheet has the title “Towards New Requirements Engineering Competencies” and was created by Sami Jantunen, Rex Dumdum and Donald C. Gause.

This paper was published in the “2019 IEEE/ACM 12th International Workshop on Cooperative and Human Aspects of Software Engineering (CHASE)” conference, pages 131 to 134 in 2019.

1. **Theme of the paper**
2. Scientific area, specific topics.

This paper focuses on the new competencies needed when expanding requirement engineering (RE) practices to cope with complex systems in dynamic environments with the discussion focusing on how an increase in complexity affects RE practices and what viewpoints have been found most salient when aligning RE practices with the design problem at hand.

1. **Synthesis of the paper**
2. Motivation and importance of the research

The creation of this paper was motivated by the drastic changes in the environment in which requirement engineering is practised through the years.

In the early days, design problems were thought of as having strong links with mathematics and science with no single generic solution to bridging gaps between user needs and technological capabilities existing, later RE evolved towards designing and defining functionality with the task of software engineers becoming the implementation of software that models the reality of the stakeholders and now the focus has started to shift towards the understanding and defining requirements.

However, while the idea of requirements has changed, RE research still develops formal and computational models for reasoning about requirements, while remaining largely atheoretical in its view of RE as a socio-technological endeavour. This struggle of the research community to keep pace with the evolving nature of design problems has been argued to lead to most RE-related difficulties in the field leading to the need to take a fresh perspective.

1. Main points of the background informations and state-of-the-art

The paper starts by examining **how complexity affects RE efforts**, stating that a lot of traditional scientific work has been done with the supposition that the unknowability of situations is due to a lack of information which in turn led research to focus on uncertainty reduction through ever-increasing information seeking and processing to avoid surprises.

However, when talking about complex systems, uncertainty becomes an unavoidable part of the RE process since according to the complexity view, products whose requirements need to be managed, co-evolve with their environment leading to satisficing solutions with surprises and changes along the way. This creates a need to expand and deepen the range of theoretical frameworks that help conceptualize new RE complexity and generate strategies to mitigate its effect.

The other topic touched upon by the article is the **adequate fit between RE practices and design problems**. This, has been argued, can be a matter of considering three core aspects: the nature of the design problem, the nature of the environment and the beliefs of the requirement engineer.

In terms of the nature of the design problem, the paper identifies two types of problems according to the Cynefin framework:

* *simple and complicated* - assume an ordered universe where cause-and-effect relationships are perceptible, and the right answers can be determined based on facts.
* *complex and chaotic* - unordered with no immediate relationship between cause and effect and the way forward must be found with emerging patterns.

*Complex and chaotic* problems, specifically, need different, often counter-intuitive, responses since we often only understand why things happened in retrospect and therefore, they require an interactive and experimental approach. In this case practitioners’ primary job is to establish order, then sense where stability is present and from where it’s absent and finally respond by working to transform the situation from chaos to complexity. The identification of new patterns can help prevent future crises and discern new opportunities.

When it comes to the nature of the environment, it can be *stable* or *dynamic* with the latter often being related to requirement volatility.

Traditional RE approaches often focus on stable environments with the belief that requirements should be established at the beginning of the project and changes should be avoided, however, it is now understood that requirements changes are unavoidable, and this is not necessarily due to bad RE practices. This reality points towards the need to gain better awareness of the strengths and weaknesses of different process models for handling volatile requirements with RE becoming more of a learning than a gathering process where changes should be expected and welcome.

Finally, the topic of the beliefs of the requirements engineer stems from people having different perspectives on tools, techniques, and approaches to RE problems which brings into question if RE is fundamentally *objective* or *subjective*.

The *objective* perspective has as a main goal of nailing down requirements early with concreteness which leads to a focus on the creation of static well-defined understanding emphasising the importance of basing RE approaches on systematic protocol and technique.

Meanwhile, in the *subjective* perspective, requirements are based on shifting knowledge and circumstances where interpretations are variable with the objective of refining requirements perspectives. This leads to requirements engineers needing to be more creative and less deterministic since complex situations are fluid and uncertain.

Examining these beliefs is important to make sure that the practitioner’s beliefs do not contradict the nature of the design problem and create conflicts in RE for complex situations.

1. Main findings and results and their novelty

The main finding of the paper is that most RE practices play differently depending on their context, therefore, determining effective ways to deal with a given design problem requires **contextual intelligence.**

**Contextual Intelligence** refers to the ability to recognize and diagnose contextual factors inherent in an event or circumstance and then intentionally and intuitively adjust behaviour to exert influence in that context.

The previous discussion about the adequate fit between RE practices and design problems described above already describes some aspects that are important in increasing the chances of RE effectively dealing with a design problem. However, to further improve contextual intelligence, we need to not only understand the nature of contexts and how to know when traditional approaches are beyond the limits of their applicability but also to develop new RE approaches for dealing with complex situations.

This can be quite challenging because people tend to have a bias towards approaches that have worked for them in the past, a phenomenon known as *Paradigm Paralysis*. The authors of the paper believe that contextual intelligence can help overcome this paradigm, however, they also point out that this requires requirements engineers to let go of assumptions about what will and won’t work and then experiment to find out what does, in fact, work.

Finally, progress has already been made towards the issue of complexity with the widespread adoption of agile RE. However, it’s necessary to point out that even this might not be the final step of software development with software companies moving more towards R&D *as innovation experiment system* which takes steps towards experimentation, learning, empowerment of practitioners and the emergence of solutions all strategies suggested to deal with complexity.

1. Main conclusions and/or discution points

The paper concludes that to foster contextual intelligence and deal with the ever-increasing complexity of today’s software needs to pay attention to not only **horizontal development** but also **vertical development**. While horizontal development refers to the development of technical skills that can be transmitted, vertical development instead refers to personal skills that must be earned by individuals which in turn helps them think in a more complex way.

To foster these types of skills it might be interesting to investigate disciplines such as organizational studies, complexity sciences, leadership studies, psychology and educational studies which lead us to label the following competencies as the most important when trying to act in complex situations:

* Learning to learn – Ability to let go of biases that might be hindering our progress.
* Sensemaking - Ability to come up with a plausible understanding of something and then test it and decide if it should be refined or discarded depending on how credible it is.
* Dialogue – Ability to use people’s differences to enhance collective wisdom by speaking one’s true voice and encouraging others to do the same while listening and respecting their views.
* Mindfulness – Commitment to be attentive and preoccupied with failures in the system and being reluctant to simplify the interpretations of failures.
* Facilitative leadership – Ability to:
  + Use active listening skills.
  + Encourage and foster discussion.
  + Help stimulate creative thinking.
  + Simulate strategic consideration of alternatives and informed decision-making.
  + Manage contrasting opinions that might result in conflict.
  + Help individuals reflect on experiences and learn from them.
  + Help share better questions for exploration.

Finally, the paper mentions that this need for vertical competencies has already been acknowledged by literature with the trend being for leadership to become more distributed across organizations and more adaptative and facilitative by nature. In this way, leadership is often required from the RE practitioners when problems are novel or have not been experienced before.

1. **Questions and reflection**
2. Questions raised by the reading of the paper

The paper raises questions about the new challenges that requirements engineers are currently facing and what kind of skills they need to develop to deal with complex systems in dynamic environments.

1. My opinion about the paper

The paper very clearly outlines two of the major issues currently affecting RE practices with these being the increase in complexity and the ever-increasing influence of the environment in these processes, which, in my opinion, with the evolution of software, are two very important issues that must be addressed by practitioners and researchers alike due to the speed at which complexity increases and with it brings more volatile requirements. Since uncertainty in these situations is inevitable it only makes sense that we need to stop looking for ways in which to avoid uncertainty as it has been done in the past and start discussing what types of skills are necessary to problem-solve in this environment and achieve the best results when defining requirements.

I also believe that the focus on vertical development or soft skills that mostly involve improving communication, discussion and thought as outlined in the paper is a very understated part of the current reality of requirements engineering with the old idea of requirements engineers simply eliciting the requirements from stakeholders without any input in still not having faded completely despite the current reality of the discipline.

1. What to retain for my future research/professional practice

I think it’s important to be mindful of the important roles that discussion and dialogue have in the requirements engineering process and to not forget that, with the increasing need to deal with volatile ever-changing requirements, this process has become much more creative on the part of requirements engineers and a different type of effort must be put forth when designing software systems.

Finally, the focus on contextual intelligence is also essential to understand what kind of practices should be applied when faced with problems in the RE process with the important fact that we should keep in mind not only the nature of the environment and design problems but also our own beliefs and how they affect our thought process in negative ways when faced with the current problem to let go of pre-conceived notions that might be halting our progress.

**Joana Teixeira Mesquita**

[up201907878@edu.fe.up.pt](mailto:up201907878@edu.fe.up.pt)

Engenharia de Requesitos

Mestrado em Engenharia Informática e de Computação (M.EIC)