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Generative rules for more creative thinking about requirements

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Generative AI technologies can fulfil multiple support roles in software and requirements engineering work. One is to augment creative thinking, i.e. the production of more novel and useful outcomes. Many requirements engineering activities involve problem solving of one form or another. This problem solving often generates creative outcomes such as new concepts and requirements, which in turn can lead to software-based innovations. It is an intrinsic part of requirements work.

Even simple uses of generative AI technologies have already been shown to enhance human creative thinking. Chatbot interactions have been used to generate large numbers of potentially new and useful ideas with which to solve problems (e.g., Dell'Aqua et al. 2023).

However, many of these current uses have not exploited published knowledge about how to be creative. Numerous creative thinking methods and techniques have been available for decades, and demonstrated repeatedly to be effective for generating novel and useful outcomes.

In this column, I argue that requirements professionals should exploits these methods and techniques to direct generative AI technologies to produce more novel and useful outcomes, regularly and efficiently.

Some generative AI basics

Generative Pre-trained Transformer (GPT) neural networks seek to predict accurate sequences of words for input text prompts using Large Language Models (LLMs) trained on massive language datasets. Well-known examples include GPT-4o and Claude-3. Most users interact with these models via chatbots, although public APIs have enabled digital tools including requirements analysis and management tools to interoperate with these models automatically. GPTs also exist to generate images and, increasingly, videos with different degrees of user control over this generation.

How organisations make best use of these LLMs is also evolving. Many are now generating local LLMs from their in-house information to support professionals to solve local problems, and/or deploying growing libraries of increasingly sophisticated prompt templates that these professionals can select and adapt for different tasks.

That said, LLMs are not intelligent. Each model simply generates a statistical prediction about the best-fit response to a user input, hence the often-quoted description of generative AI as text prediction on acid.

Generative AI for creative thinking

Nonetheless, many empirical studies in professions from architecture and design to creative writing and consulting work have demonstrated generative AI's positive effects on ideation. E.g., chatbot use supported people to explore larger problem and solution spaces and generate more ideas (Dell'Acqua et al. 2023), and enhance creative thinking by offering new novel ideas (Doshi & Hauser 2023).

However, although the novelty of outcomes for individuals increased, the collective diversity of novel content is sometimes reduced (Doshi & Hauser 2023). And professional knowledge workers from multiple industries including software development also envisioned that generative AI use may also amplify negative social forces such as deskilling, dehumanization, disconnection, and disinformation (Woodruff et al. 2024).

Nonetheless, evidence does suggest generative AI use in different professions can increase the number and novelty of outcomes that individuals produce. So, what about in requirements work?

Generative AI uses in requirements work

There are relatively few reports of generative AI uses in requirements work, although this does not mean that use is not happening. Most published reports have focused on specific requirements tasks with more sophisticated uses of LLMs. E.g., LLMs were used successfully to evaluate quality characteristics of software requirements according to a published standard (Lubos et al. 2024) and to generate context-specific test scenarios from natural language requirements (Arora et al. 2024).

In our own work, I have observed that even simple chatbot interactions with LLMs can add value to requirements tasks. Consider the simple prompts to ChatGPT-4o in Figure 1 that return hypothetical new requirements and stakeholders. The chatbot acts as an advisor, offering nudges to increase requirements completeness, correctness and value. Dozens of similar other requirements engineering prompts are possible.

Prompt 1

Consider the following requirements challenge.

[Requirements challenge description]

As an experienced requirements analyst, generate five novel functional requirements and five quality requirement descriptions. Each description should be structured according to the VOLERE template.

Prompt 2

Consider the following requirements challenge.

[Requirement challenge description]

As an experienced requirements analyst, name and describe in one sentence ten important but unexpected stakeholders in a solution that meets this need.

Figure 1. Examples of simple prompts to ChatGPT-4o to support two basic requirements engineering tasks

However, one limitation is that these prompts do not incorporate existing knowledge about how to be creative, even though the prompts request novel and unexpected outcomes. Creative thinking knowledge from established methods and techniques to direct the generative AI is missing. Let me elaborate.

Creative thinking knowledge, skills and generative rules

Amabile & Pratt (2016) identified 3 major components necessary for human creativity: expertise, intrinsic task motivation, and creative thinking skill. In requirements work, I observe that most practitioners have requirements engineering expertise and intrinsic motivation but lack the creative thinking skills needed for regular problem solving. Without these skills it is difficult to be creative, with and without generative AI. So where might these skills and the associated creative thinking knowledge come from?

Creative thinking practices in its current form emerged in the 1950s with new processes for creative problem solving. Most of these processes can be characterised as multi-step sequences of goal-directed tasks that use specific types of input to generate specific output types, not dissimilar to some structured requirements methods. In my own work, similar structured uses of techniques such as analogical reasoning were demonstrated to support creative thinking about requirements for software-based systems.

These creative thinking processes were often derived from structuralist models that describe creative problem solving as iterations of divergent and convergent thinking. This divergent thinking is intended to manipulate information to generate many possibilities and the convergent thinking to generate fewer, more complete ones. Within this framing, Boden (1990) distinguished between two types of creativity – exploratory and transformational. Exploratory creativity assumes a defined space of partial and complete possibilities to explore – a space that also implies the existence of rules that define the space. Changes to these rules produce what might be thought of as a paradigm shift, called transformational creativity (Boden 1990). Ideas that are novel and useful are reached in the space by a set of what are called generative rules for divergent thinking and convergent thinking. Boden also identified one specific form of exploratory creativity, called combinational creativity, which is the process of making unfamiliar connections between familiar items in the pre-defined search space, using a different set of generative rules (Boden 1990). Different creative thinking processes, methods and techniques implement versions of these generative rules in different combinations.

Many published creative thinking techniques support one of Boden's three types of creativity. E.g., the *constraint removal* (Onarheim 2012) and *assumption busting* (Michalko 2006) techniques both direct their users to challenge the constraints and assumptions related to a problem and hence change the rules that frame a space of possibilities. These techniques support transformational creativity. The 40 *TRIZ inventive principles* (Altshuller 1999) and the *creativity triggers* technique (Guinta et al.

2022) both direct users to discover possibilities in a space that have qualities associated historically with more creative outcomes – qualities such as *asymmetry* and *playfulness*. Each quality can be operationalised as one or more generative rules with which to discover possibilities and support exploratory creativity. And techniques such as *heuristic ideation* (e.g., Tauber 1972) use the timelines of stories and combination matrices respectively to implement rules with which to make unfamiliar connections between familiar pieces of information and therefore support combinational creativity.

So, what does all of this mean for more creative requirements work using generative AI? One answer is to construct prompts that generate useful and novel responses through the incorporation of generative rules for creative thinking. The next section includes a simple demonstration using rules from one creative thinking technique.

Incorporating generative rules for creative thinking

Another technique, called SCAMPER (Serrat 2017), guides people to explore problems and possible solutions from different perspectives, e.g., by substituting one element for another, or eliminating an element all-together. Each of the seven perspectives can be framed as a generative rule that can be used to reach novel and useful ideas in a large space of possibilities. Figure 2 demonstrates how the two prompts from Figure 1 can be extended with these generative rules to generate more creative outcomes. Try them out on your own requirements challenges.

Prompt 1

Consider the following requirements challenge.

[Requirements challenge description]

As an experienced requirements analyst, generate five novel functional requirements and five quality requirement descriptions. Each description should be structured according to the VOLERE template. To generate each requirement, apply one of the following generative rules to discover more novel and useful outcomes:

- S - Substitute: replace one element or component of a challenge with something else.
- C - Combine: merging different elements or ideas to create something new.
- A - Adapt: modify or adjust an existing idea or product to better suit a specific context or purpose.
- M - Modify: make changes or alterations to an existing idea or product.
- P - Put to another use: explore alternative applications or purposes for an existing idea or product.
- E - Eliminate: identify and remove unnecessary elements or steps from a process or solution.
- R - Reverse: flip the perspective or approach to a challenge.

Prompt 2

Consider the following requirements challenge.

[Requirements challenge description]

As an experienced requirements analyst, name and describe in one sentence ten important but unexpected stakeholders in a solution that meets this need. To generate each stakeholder, apply one of the following generative rules to discover more novel and useful outcomes:

- S - Substitute: replace one element or component of a challenge with something else.
- C - Combine: merging different elements or ideas to create something new.
- A - Adapt: modify or adjust an existing idea or product to better suit a specific context or purpose.
- M - Modify: make changes or alterations to an existing idea or product.

<p>P - Put to another use: explore alternative applications or purposes for an existing idea or product.</p> <p>E - Eliminate: identify and remove unnecessary elements or steps from a process or solution.</p> <p>R - Reverse: flip the perspective or approach to a challenge</p>

Figure 2. A simple example of two prompts to ChatGPT-4o that incorporate seven generative rules extracted from the SCAMPER technique to support two requirements engineering tasks

Five takeaways

My experiences indicate that, without explicit use of creative thinking knowledge in the form of generative rules, it is difficult to push generative AI technologies to go beyond homogeneous machine-generated ideas. So, let me finish with five simple takeaways to make your requirements practices more creative.

Master creative thinking: As I've reported, many methods and techniques for creative thinking were developed have been available. So go back to basics. Read about these methods and techniques. Develop a basic mastery of some generative rules to use to direct generative AI technologies.

Develop your personal libraries of requirements prompt templates: One consequence of mastering some creative thinking techniques is that you will develop your favourites to use, both with stakeholders and generative AI chatbots. Build up a robust set of prompt templates that link generative rules for creative thinking with the forms of requirements challenges that you encounter in your work and the desirable formats of these outcomes – formats such as requirements templates, models or reports. The examples in Figure 2 are simple starting points to inspire you.

Bespoke creative requirements tools: Chatbots offer only limited support for human creative thinking. There is limited support for exploring multiple ideas concurrently, and reworking prompts in response to answers that do not meet your needs can inhibit the creative flow needed for effective ideation. One solution to overcome these limitations is to develop bespoke tools developed to support co-creative requirements work using published APIs to LLMs. These tools have the potential integrate creative thinking and requirements analysis techniques seamlessly, as well as give analysts and stakeholders more agency in creative requirements work. E.g., Design Sparks <https://designsparks.io>, although not a tool specific to requirements engineering work, provides users with semi-automates versions of different creative thinking techniques to generate more creative questions about and answers to design problems. Try it out. How could it be adapted to your work?

Use generative AI to ask questions: Most people think of generative AI as providing answers to questions that users ask – an approach that shortcuts human problem solving. But it does not have to be this way. Generative AI can just as well be used to encourage users to be more creative and more critical in their thinking – most professionals are just not using it that way with it at the moment. So, explore how creative thinking can support your requirements work, and set up prompts to provoke

creative and critical thinking about requirements, to ask new questions rather than just seek answers.

Rethink your roles in requirements teams: the automation of work previously the preserve of professionals is already having consequences in many professions. One is the distribution of expertise, i.e., non-professionals now able to undertake professional work. This might mean stakeholders leading some aspects of requirements work, and requirements professionals becoming the facilitators of this work. Another is an increasing focus on soft skills such as communication and aspects of creative problem solving that are harder to automate. There will be implications for requirements training and certification. Try to stay one step ahead of the change.

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