TPC#1 Research – 1MIEIC04 Team 4

Francisco Sousa, João Miranda, Luís Alves

As we are familiar, the ever-growing complexity of products has been introducing challenges to engineering teams in the way they manage the development process. With each generation of products exponentially offering more features and functions, their requirements, design and testing efforts necessarily increase as well. For this reason, engineering teams must adopt new tools that can help them not only improve efficiency, but also manage development processes.[1]

As of now, we are at a place we've never been before, where engineering teams are using powerful and sophisticated AI machines to perform the repetitive, boring tasks and help them manage the large amount of data that current products require to be able to run.[1]

Across almost every industry, the systems engineering has become more and more complicated, where the new products generate data that has to be collected, organized and handled in the rightest way, delegating great responsibility to everyone involved in the process.[1]

What is really granted?

IBM is one of the major corporations that has already started using AI to develop innovative solutions, helping the communication optimization and collaboration between teams maximizing productivity.

Benefits:

- Improve product quality: record, trace, and evaluate the needs for intricate systems and products. Change and configuration management are integrated directly into the requirements tool, giving you complete control over project costs.
- Manage compliance: managing traceability including engineering artifacts and software.
- Reduce cost: minimizing the risk and improving the performance of the teams gaining time in the market.
- Reduce time to market with reuse: utilizing engineering effort that is valuable by managing product versions and variants well. Establish a baseline that will allow data to evolve consistently amongst engineering disciplines. To increase output and quality across variants and programs, use the baseline.
- Improve project agility with concurrent editing: by using efficient prioritization, automated versioning, and concurrent editing, you may improve teamwork and project agility. Access required databases in real time without interruption or conflict for several users.
- Support requirements development: managing requirements across all engineering domains.

A wide range of features are available in IBM's AI-powered requirements management solutions, all of which are designed to boost productivity, teamwork, and quality across the product development process. By defining data models, types, and attributes as well as structuring modules, folders, and hierarchical views, these solutions let users create and arrange their projects. Additionally, they provide views, tagging tools, and filtering options that may be customized to assist teams quickly focus on pertinent project data.

With comprehensive text editing and graphical sketching options including use case diagrams and business process models, both textual and graphical tools are accessible to improve the depth of project documentation. The platform facilitates the linking of artifacts and the visualization of linkages through a graphical links explorer, hence ensuring traceability throughout the project.

Tools that facilitate collaboration further include review workflows, comments, and AI-driven enhancements to requirements documents. Furthermore, facilities for work management and quick onboarding of new team members facilitate the development process. Multiple project streams and variations can be handled more easily with the help of configuration management solutions, which enable global administration and reuse of configurations, baseline tracking, and change histories.

Reporting-wise, automated reporting tools facilitate compliance and quality checks, while real-time metrics, progress tracking, and customizable live dashboards offer insights into the state and advancement of projects. All these features come together to provide a powerful system that helps companies improve overall production and product quality while managing project scope, cost, and regulatory requirements.

IBM offers DOORS Next and DOORS, two strong requirements management solutions that address different project needs.

- DOORS Next is an adaptable web-based platform intended to improve stakeholder and team collaboration and communication. It enables businesses to guarantee adherence to industry rules and standards while capturing, tracking, analyzing, and managing required changes. This solution works very well for managing project scope and budgets across supply chains, so it's a good fit for tasks that require a lot of cooperation and strict adherence to regulations.

- DOORS is an established requirements management solution that has been used in intricate, high-compliance engineering projects for many years. It provides a wide range of features, such as baselines, multi-level traceability, support for electronic signatures, round-trip data import and export, and structured requirement specification modules. This solution ensures efficient monitoring and control throughout the requirements lifecycle, making it perfect for teams handling intricate and regulated projects.

In conclusion, both solutions, DOORS Next stressing contemporary, scalable collaboration

and DOORS offering a sophisticated, feature-rich platform for highly regulated environments, are built to solve the unique difficulties faced by teams working on complex projects.

Following the deployment of the IBM Requirements Management solution with RQA, some IBM clients have reported:

- Up to 60% reduction in the cost of defects.
- Up to 25% reduction in the cost of manual reviews.
- Up to 57% reduction in development cost.
- Up to 20% acceleration in time to market.

Requirements Elicitation

This stage outlines the procedure for gathering data from all potential sources that might be pertinent to the product that is being developed. Stakeholder interviews, market research, examination of national and local laws, and internal requests are a few examples.

AI can help in many different fields. First, conversational AI systems that ask pertinent questions and nudge stakeholders for more information might enhance the process of getting ideas and comments. Faster and more comprehensive survey or interview question generation can also be facilitated by AI solutions.

Second, AI can access next-level market knowledge and serve as a cooperative brainstorming partner to generate more innovative ideas. Without the need for specialized analysts to create intricate SQL queries, it can sift through big, complicated documents (such international compliance requirements) or carry out various forms of market analysis (consumer trends, rival simulations, etc.) and ease data mining across several sources.

The essential elements may then be condensed by AI into a cleanly structured report. AI can also provide further ideas from the historical usage and incident analysis if this isn't the product's first version.

Finally, the "culmination" of requirements elicitation may be sped up by using AI technologies. As they say, a rough prototype that is developed fast and without using the bandwidth of other teams is likely worth a million dollars.

The ability for non-technical users to develop simplified prototypes using visual interfaces and pre-built components even before the requirements are explicitly stated is one of the main advantages of no code/low code AI platforms. For instance, CAD and other design applications may be combined with generative AI. Business analysts and interaction designers will need to learn how to direct visual AI as it quickly advances, rather than relying solely on their own expertise in designing websites and business processes.

Requirements Documentation

This stage outlines the procedure for turning the data acquired during elicitation into formal artifacts appropriate for the process of developing new products. These artifacts often take the kind of semi-structured text, but they can also include custom attributes, flowcharts, use-

case models, mind maps, and other visual representations. Effective requirements writing is essential for maintaining compliance with standards like ASPICE and ISO 26262, which are increasingly relevant to complex automotive software systems.

Here, the main use of AI is rather simple: it creates requirement papers from descriptions in natural language. This can be especially useful for more readily turning visual information into structured text or for gathering higher-level specifications from non-technical stakeholders.

Another example would be to provide the AI tool the transcript of the Teams call from the design brainstorming session so that the structured documentation is produced more rapidly. Bard is one of the appropriate tools; given a set of input specs, it may provide requirements descriptions in plain language.

To make it simpler to create tests using AI in the future, we can think about asking AI to generate requirements in a prompt-like format in anticipation of future phases of product development.

Being pre-trained on the INCOSE Guidelines for Writing Requirements is one of the characteristics to consider when selecting the AI tool/model for this RE phase. This helps identify and avoid a variety of quality concerns.

Requirement analysis

Verifying that the company-specific artifact formalization guidelines have been followed is the aim of this phase. It is imperative for stakeholders to ensure that every item contains a minimum number of ambiguities, dependencies, and inconsistencies. The foundation of successful project delivery is a set of well-defined and exhaustive business requirements that guarantee that all stakeholders are in agreement on the intended results.

In line with earlier stages, the AI models can offer suggestions to remove doubts, reveal hidden requirements, and spot contradictions, inconsistencies, or gaps in data by means of interactive conversations.

Business analysts can describe the process, for instance, to Siemens' Teamcenter or ChatGPT, and these platforms can attempt to identify areas that need attention, such as those where bottlenecks or inefficiencies are anticipated. Alternatively, AI may constantly check the most recent iterations of compliance standards against current requirements to stop violations of pertinent laws and regulations in a given business.

Requirements verification and Refinement

Product development deliverables (such software code or field simulations) are examined during this phase. The objectives are to guarantee that all criteria are met and to encourage RE improvements for next product cycles. Accelerated feedback loops and iteration are the key concepts.

We shall concentrate on other topics here because we covered the testing component of verification in the earlier sections.

Not simply design prototypes but also functional proofs of concept, or minimal viable products, may be created and implemented more quickly thanks to AI technologies. This makes it possible for users to evaluate several versions fast, assess how well they work, and pinpoint areas that need improvement for the upcoming requirement cycle.

Because human root cause investigation may greatly increase workload, AI-powered methods can also be used in production to monitor, detect, and categorize issues (e.g. continuous profiling using ML-powered Amazon CodeGuru Profiler).

AI models have the benefit of ongoing learning and development when it comes to refinement. Through feedback and interaction, stakeholders may help the AI systems learn and improve their comprehension of the unique requirements over time. Through this iterative approach, problems are identified and fixed as soon as feasible, ensuring that the requirements are updated and in line with evolving business demands.

This might involve activities like maintaining requirements dependencies, tracking modifications, and creating reports. By doing so, better evidence-based choices concerning the subsequent iterations of the product development lifecycle can be made. It permits business analysts to dedicate more time to obtaining more profound understandings.

AI cons

While AI-assisted software development offers numerous benefits, it's important to recognize some of its drawbacks. Here’s a look at the potential cons:

- A hefty upfront outlay: AI integration into the software development lifecycle necessitates a significant time and resource commitment. This covers the price of manpower, software, and gear. This process's resource-intensiveness may make it difficult for some firms to enter, therefore it's important to carefully weigh the advantages over the disadvantages.
- Limitations on Creativity: the fact that AI systems follow preset guidelines and structures may restrict their capacity to produce truly original thoughts. These algorithms may have trouble coming up with novel ideas, which could impede creativity during the development process even though they can analyze large datasets and make predictions.

- Possibility of Inaccuracies and Bias: the caliber of the training data has a direct impact on how effective AI systems are. Inaccurate predictions and results will result from biased algorithms if the training data is biased. These errors may have a major impact on the dependability and quality of software.

- Using Algorithms Too Much: the creativity and critical thinking abilities of software engineers may be compromised by an overreliance on AI tools. Developers may overlook their problem-solving skills as they rely more on AI to make decisions, which would lead to a lack of creativity and innovation in their job. In the end, this reliance can impede the development and expansion of the software development industry.

- Software development with AI support is probably going to continue to be a big part of the business. Although its benefits are significant, companies need to carefully balance them with any potential disadvantages in order to make decisions that are in line with their unique goals. It's critical to see artificial intelligence (AI) as a supplementary tool that works in tandem with human developers to enhance software development.

[1] [AI for engineering requirements | IBM Watson IoT] https://www.ibm.com/internet-of-things/learn/ai-for-engineering-requirements/

[2] [Engineering Requirements DOORS | IBM] https://www.ibm.com/products/requirements-management

[3] [Pros & Cons of AI in AI-assisted development | Binmile] https://binmile.com/blog/pros-and-cons-of-ai-assisted-coding/

[4] [IBM Engineering Requirements Quality Assistant - IBM Documentation] https://www.ibm.com/docs/en/erqa?topic=engineering-requirements-quality-assistant