

# Enhancing 3D Design Review Cycle Utilizing Artificial Intelligence

▲ By Saeed Alyousef, Emad Alsafi

## INTRODUCTION

Good design is vital for attaining value for money in construction of Plants and Facilities. More importantly, all 3D designs should provide the arguments and evidences that the developed model meets high quality and safety standards. 3D models are part of project deliverables to Saudi Aramco related projects and shall be submitted at 30%, 60%, 90%, Issued For Construction (IFC) and 100% As-built with all drawings matching with level of development as per Mandatory Saudi Aramco Engineering Requirements. Engineering and 3D Model reviews cycles are essential part of company procedures and standards to control and assure 3D model is being developed in accordance with all applicable Saudi Aramco Standards, Procedures, and other mandatory requirements at all stages of project development. There are three key review cycles required at project milestone 30%, 60%, and 90% phases, each takes around 4 to 6 weeks at least. Those reviews cover all engineering disciplines to assure the integrity of 3D model and its compliance to company requirements. During review phases, engineers from multiple disciplines manually check plant layouts making sure 3D model complies to company standards providing maximum of safety and exposure protection from the spread of fire or any potential

hazardous and risks. Reviews also considers operational accessibility and maintainability standards bearing in mind economical design avoiding any conflict or non-compliance during construction and operation. In addition, design review goes even beyond to check on requirements for future expansion to avoid any future conflicts especially when it comes to mega projects like Marjan Tanajib Gas Plant which has high potential to expand. Therefore, enhancement in design review is necessary for smooth and efficient project execution.

## PROBLEM STATEMENT – CHALLENGES

There are several challenges that engineers and project managements face during 30%, 60%, and 90% 3D model review cycle.

One major challenge is time and resources needed to validate 3D Model after development. At each review cycle 4 to 6 weeks needed of dedicated engineers from all disciplines and stakeholders which overrun burden project management in project execution since there are huge number of items to check when it comes to mega project like Marjan Gas Plant. 67% of violations found related to safety violations during 60% phase review of Marjan Gas Plant Package 12 which impacted project in design execution and needed to be avoided.

Quality and efficiency of review is another challenge as number of items being

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reviewed manually are huge leading to lower quality and eventually could risk project in execution and delivery by missing important non-compliance items which ultimately impact quality, safety, and integrity of project execution and handover.

Conflict and deviation from design during construction due to site condition in as built drawings is also critical challenge to project delivery and found a lot in mega projects like Tanajib Gas Plant since as built drawing not subjected to any cycle review while changes in 3D models occurred.

Additional challenge is that absence of business system to capture reviewed items during 3D Model cycle reviews and channels used to communicate them could lead to lose track and record of non-compliances when they are being communicated with multiple discipline and stakeholders.

In addition, quality management framework mandates design reviews which are being conducted after each phase and not continuously through the design which lead to more findings and non-compliances that ultimately lead to lots of reworks. Ultimately, changes during later phases of project are crucial and leading to high risk of violations to safety, operational accessibility, maintainability, and hazardous which should be avoided at an earlier stage.

## INTRODUCING ARTIFICIAL INTELLIGENCE DESIGN QUALITY CHECK SOLUTION

Due to above challenges Saudi Aramco Project Management Team decided to enhance quality, efficiency and reliability of review cycles. DQCS (Design Quality Check Solution) provides innovative solution that enhance review of designs utilizing an outstanding technology through sophisticated codes and algorithms based in company's plant layout rules embedded in the system. It applies Artificial Intelligence to validate native 3D design against pre-defined rules and values based on company's standards to make sure design is complying to company standards and helps mitigate any risk during construction and operation. The main purpose of DQCS is to improve design quality through an automated check process based on company's design basis to prevent re-work on the construction site and to eliminate potential operational accessibility, maintainability, safety and hazardous issues in advance all in one integrated system for efficient plant operation. DQCS plays significant role in mitigating risks associated with re-works and violations to safety and operational standard even during as built phase. It is an efficient and reliable solution that covers all company standards and highlights any non-compliance and violation automatically and artificially. DQCS can be applied to any future 3D Model for MEGA Project leading for more efficient project execution and cost saving.

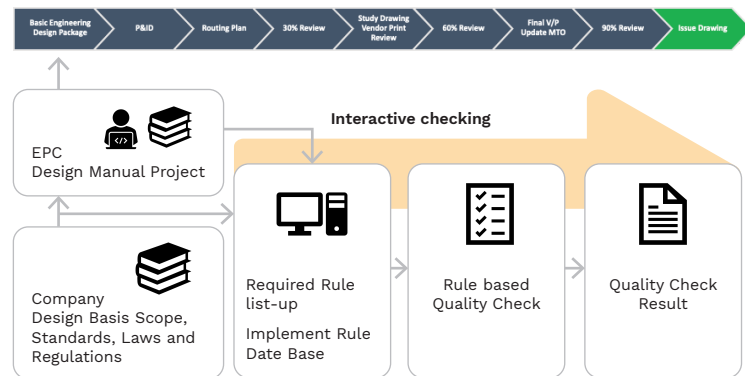
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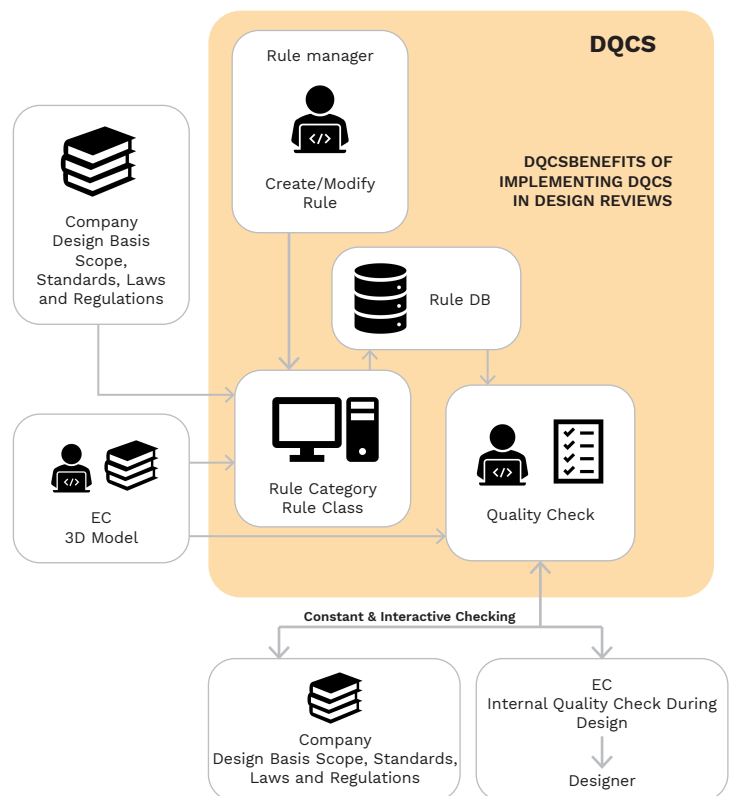
## HOW DESIGN QUALITY IS MEASURED USING DQCS

During development of 3D model, DQCS can be embedded in native file to run and validate the design utilizing Artificial Intelligence using sophisticated codes. It evaluates and validates 3D model design, safety and hazardous, operational accessibility and maintainability against predefined rules, parameters and arguments provided in the system. Those rules are defined in DQCS for one time and can be applied for multiple design reviews. The system uses rules and constraints which are added in a customized way in the backend code to run any 3D model designed as per company and international standard and requirement. Those rules can be updated by authorized person using interactive interface whenever there is an update in company design standard. The system is then render and captures all design violations in all discipline in one integrated system. For example, the system can automatically check spacing requirements for equipment and structures in the design and layout of new plants and expansions or modifications of existing plants in one click. It then highlights all non-compliances in 3D model in one report with all items and what specific rule is been violated for each part in facility.

## Normal Design Cycle and when DQCS interact



## Design Quality Check Diagram



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DQCS enhances design review in several aspects. It does benefit project delivery and management when comparing to conventional design reviews. DQCS advances and surpass conventional method in design reviews in numerous aspects:

- DQCS outperform in design review period and man hours can be reduced up to 75% during all review phases
- DQCS Enables efficient and powerful Quality Control collaboration in a non-face to face environments
- DQCS is proactive approach that reduces re-work on design and eventually save cost through reducing more than 15% of re-work associated costs
- Diminish time waste on 3D Model review sessions to help design modification and delivery time to execute the project especially during 60% review which is essential to start or issue construction drawings
- All Items that Violated the Design Rules are controlled by DQCS in one system for all disciplines while conventional method uses multiple channels, like, meetings, emails, multiple files for each discipline.
- Interactive and constant checking by daily, weekly, monthly, whole Engineering Duration to execute project in a Prevents non-compliance design criteria without the need to wait for 30%, 60%, or 90% design review phase as design can be checked instantly and continuously

- Complete Report can be shared across all Disciplines and/or between COMPANY and EPC Contractor
- DQCS provides a well-structured interface and better in communication as it provides organized validation reports for all non-conformance and design violation in one consolidated report for all discipline. It ensures interdisciplinary aspects in the design are addressed and validated
- Reduce time and cost for regular design review and punch list management
- Can help eliminating the use of emails, multiple review files for Design Quality Check and Punch List
- Reduce time and cost for regular design review and punch list management

## Conclusion

In conclusion, design review cycles are essential in project delivery to control and assure 3D model being delivered as per company standards and meet high quality and safety standard. Reviews ensure construction of plant and facilities reflect the value of economical and operational design respecting maximum safety and exposure protection from the spread of fire or any hazardous. DQCS utilizes Artificial Intelligence to enhance quality and efficiency of design reviews as it maintains proactive compliance culture assuring design is being developed as per company standard. Thus, implementation of DQCS in design reviews advances conventional methods as it excels

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the validation of design throughout interactive and constant checking. It plays crucial role in diminishing time waste on 3D Model review sessions and help in design modification and delivery time to execute the project especially during 60% review which is essential to start or issue construction drawings. Consequently, DQCS help in reducing rework in design and construction works which eventually save cost of any rework and delivery project efficiently in timely manner. In brief, DQCS plays important role in project management by mitigating risks associated with project delivery in terms of cost, time, safety and quality.