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COMPARISON OF VIRTUAL COMMISSIONING SYSTEMS: EKS VS ISG VIRTUOS

This article presents a comparative analysis of two leading platforms for virtual commissioning and digital twin development in industrial automation: EKS and ISG virtuos. Drawing on recent project experiences and technical documentation, the article evaluates both systems in terms of simulation capabilities, integration workflows, scalability, and practical deployment in automotive and manufacturing environments.

Keywords: *virtual commissioning; digital twin; EKS; ISG virtuos; industrial automation; simulation.*
Fig.: 4. Table: 2. References: 5.

Relevance of the research. The rise of digital twins and virtual commissioning has transformed how manufacturers design, test, and deploy automation solutions [1]. Platforms such as EKS and ISG Virtuos enable engineers to validate control logic, simulate robot paths, and optimize production lines before physical installation, reducing costs and accelerating time-to-market.

Problem statement. Modern production facilities require robust tools for early-stage validation and emulation of complex automation systems. The challenge lies in selecting a platform that balances simulation depth, integration flexibility, and deployment efficiency. This article compares EKS and ISG Virtuos, focusing on their strengths and limitations in real-world digital twin and virtual commissioning projects. In systems where production stations operate with cycle times as low as 1 second or less, the simulation must process a large number of events, signals, and part movements within extremely short timeframes.

Analysis of recent research and publications. Both EKS and ISG Virtuos have been adopted by major OEMs, including VW, BMW, Audi, GM, and Daimler, for virtual commissioning and digital twin workflows. EKS is recognized for its streamlined setup, unified licensing, and seamless integration with CAD and PLC environments. ISG Virtuos excels in multi-zone simulation, variant handling, and deep modelling capabilities, supporting large-scale deployments across multiple plants.

Uninvestigated parts of a common problem. This leads to:

- High computational load due to the simultaneous handling of many production parts.
- Increased simulation tick time, which can cause delays in signal exchange between the virtual PLC/controller and the simulated environment.
- Risk of desynchronization, where the simulation lags behind the real-world timing, potentially invalidating test results or causing false positives/negatives in error detection.

If the simulation cannot maintain a processing time that is equal to or faster than the real system's cycle time, it introduces latency that would not exist in the physical system. For example:

- A station with a 1-second cycle time expects signal feedback and actuation within milliseconds.
- If the simulation takes 200-300 ms to process a tick, the delay could distort the behaviour of the control logic.

• This can lead to incorrect validation, missed synchronization points, or unrealistic performance assumptions.

Research objective. The goal of this research is to provide a structured comparison of EKS and ISG Virtuos, highlighting their respective approaches to simulation, integration, scalability and the ability to handle large amount of production parts.

The statement of basic materials. EKS – The platform serves as a core component of digital plant solutions by enabling early software debugging and virtual integration, offering real-time emulation and interface testing across PLCs, robots, and MES systems. It supports fast deployment with minimal dependency on physical components through a unified licensing model and facilitates operator and maintenance training via integrated VR/AR modules [2].

ISG – The platform is simulation-centric, designed for adding kinematic layer, robotic modelling, and multi-zone virtual commissioning setups, and supports multi-core processing, 2D/3D modelling, variant handling, and cycle time analysis. Deployment typically requires dedicated license sets and significant labour hours for setup and testing [3]. Table 1 shows a comparison of EKS and ISC Virtuos.

Table 1 – Comparative Table

	EKS	ISG Virtuos
Simulation Focus	Real-time emulation, interface testing	Deep modelling, multi-zone simulation
CAD	Integrated with mechanical design tools	Extensive kinematic and robotic setup
Variant Handling	Supported via digital twin workflows	Detailed modelling of product variants
Licensing	Unified	Dedicated license sets
Deployment Speed	Fast, minimal physical dependencies	Labor-intensive setup and testing
Training Support	VR/AR modules for operators	VR training
Best Fit	Fast VC deployment, integration testing	Complex simulation, multi-plant modelling

Table 2 – Used hardware and software

Component	Specification
CPU	AMD Ryzen Threadripper 3970X, 32 cores, 64 threads, 3.70 GHz base
GPU	NVIDIA GeForce RTX 3090, 24 GB dedicated memory, DirectX 12
RAM	128 GB DDR4, 3200 MHz

Software	Version
RF::YAMS	v25.1.4.541 (Build Date: 2025.09.04), Plugin: rfAssistances v25.1.4.539
ISG Virtuos	v3.7.14.85896 (Release Date: 2025.09.16), Compatible with TwinCAT v3.1.4024.25 and v3.1.4024.55

The simulation was executed on a single, high-performance simulation workstation equipped with multi-core processing and advanced GPU capabilities. The research workflow followed a structured sequence, beginning with the creation of a production part using Process Simulate. The part, Fig. 1 was modelled with dimensions of 100 × 100 × 10 mm, chosen to reflect realistic components used in the automotive industry. Specifically, this part represented a battery cell, a common element in electric vehicle manufacturing.

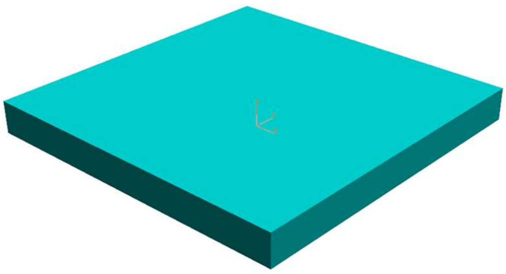

Fig. 1. Production part

Once the part was modelled, a set of reference frames was created within Process Simulate. These frames served as positional anchors and were essential for the subsequent integration into RF::YAMS, where they would be used to instantiate parts dynamically during the simulation. The complete study, including the part geometry and frame definitions, was exported as a PSZX file. This file format includes both the simulation layout and the associated library components, ensuring compatibility with downstream tools. The exported PSZX file was then imported into a new, empty project in RF::YAMS. Using the built-in YAMS assistance tools, the simulation environment was configured to support material flow logic [4]. This involved assigning the production part to the previously defined frames, configuring input signals for each frame to enable part creation, and setting up deletion signals to remove parts once their lifecycle was complete, Fig.2. These signals were critical for emulating realistic production behaviour, such as part loading, processing, and unloading.

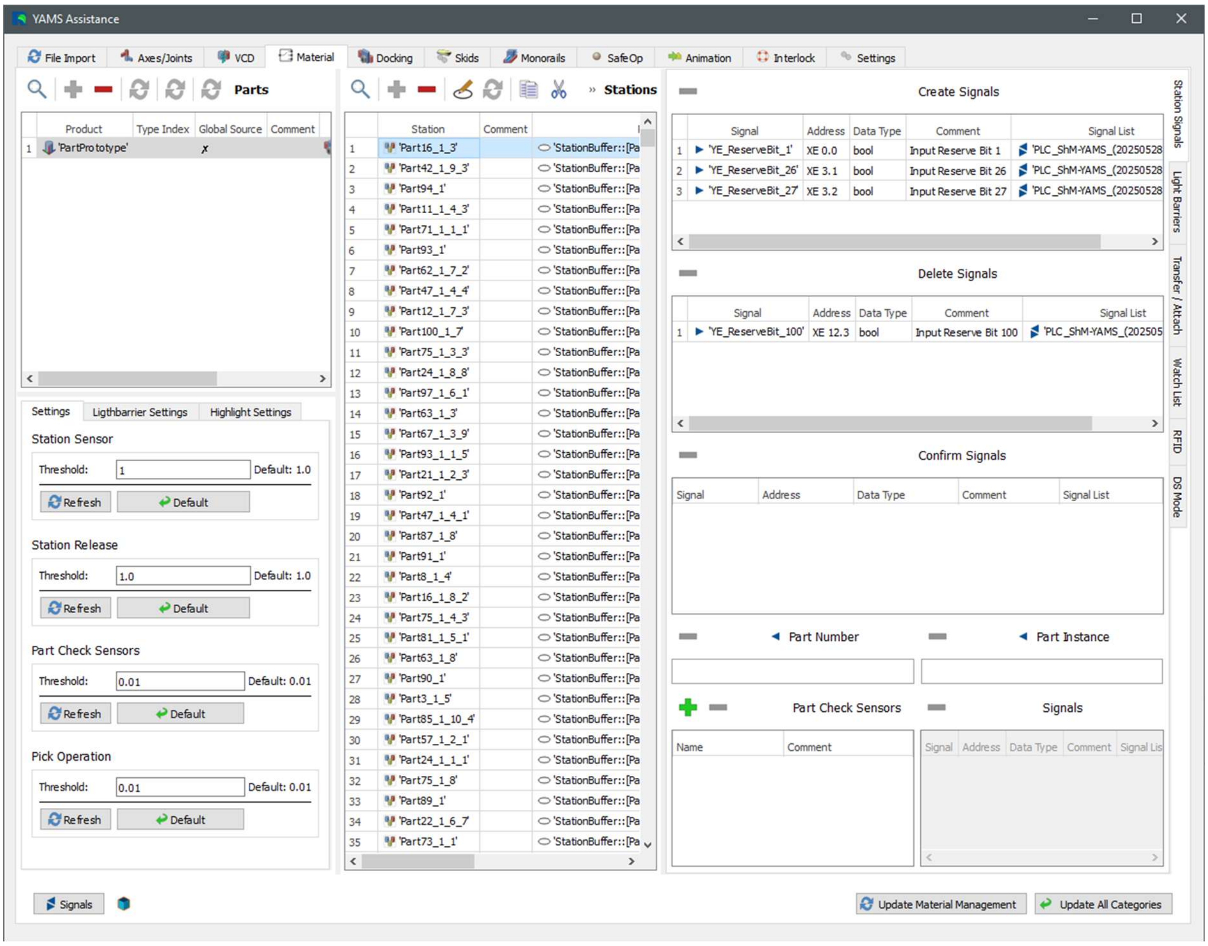

Fig. 2. YAMS assistance

Following the initial configuration, baseline performance measurements were taken with the simulation in an idle state, meaning no parts were present in the system. This provided a reference point for evaluating system load and responsiveness. The first simulation trigger was then activated, initiating the creation of a batch of 100 parts. These parts were instantiated at the designated frames. To assess scalability and system performance under increasing load, additional batches of 100 parts were introduced in successive iterations. After each batch was added, system behaviour and processing time were monitored. This process continued until the total number of parts in the simulation reached 1000, simulating a high-volume production scenario typical of automotive assembly lines. The experiment provided valuable insights into how the simulation platform handles large-scale part creation, signal exchange timing, and resource management under realistic operating conditions (Fig. 3).

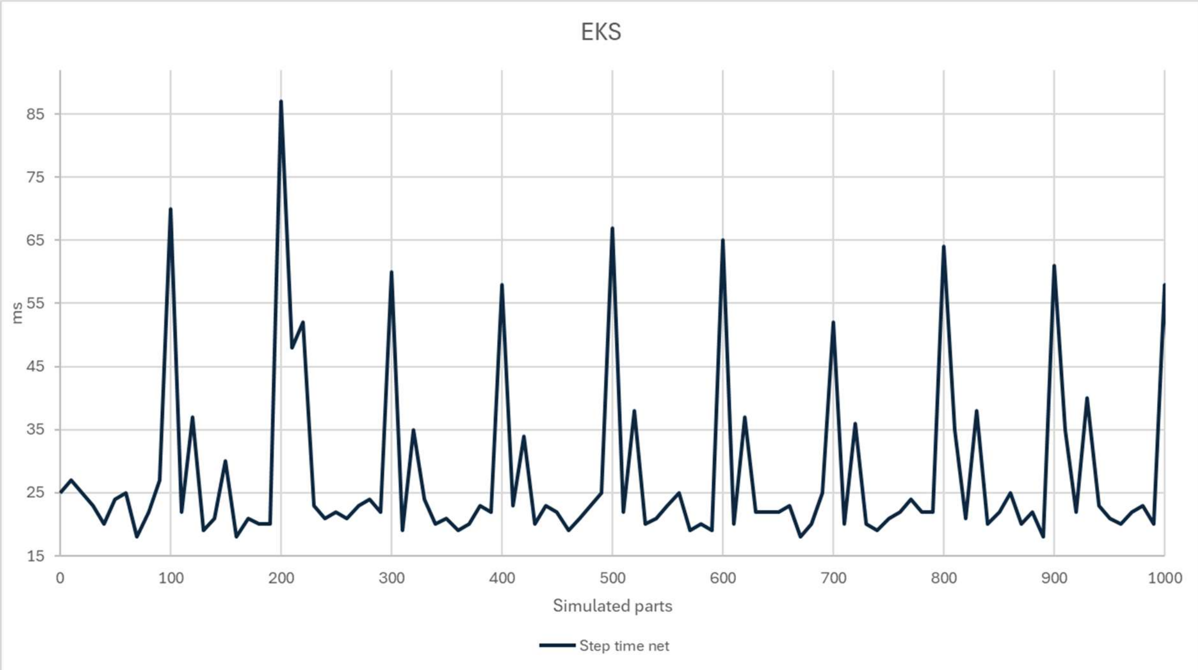

Fig. 3. EKS step time

The simulation workflow using ISG Virtuos followed a structured approach designed to maintain consistency with the baseline established in the EKS simulation. To ensure comparability, the same production part model created in Process Simulate [5]. This ensured that both simulations operated under the same conditions. The CAD geometry of the part was imported into ISG's 3D Creator module, where it was defined as a casing object. This step allowed the part to be visualized and manipulated within the ISG simulation environment. To simulate the introduction of production parts into the system, material sources were created and configured. These sources acted as generators, capable of instantiating parts dynamically during runtime. Within the World section of ISG, a storage line was added to serve as a physical platform for the parts. This line provided spatial structure and acted as a staging area for part placement and movement. To enable control over part creation, a control panel was added to the block diagram. This panel was configured to send trigger signals to the material sources, initiating the creation of parts on demand. The output from the control panel was connected to the load input of each material source, establishing a direct signal path for part generation. Once the simulation environment was fully configured, performance measurements were conducted using the same methodology as in the EKS-based simulation. Initial readings were taken with the system in an idle state, with no parts present. Then, a trigger signal was sent to generate the first batch of 100 parts, followed by successive batches in increments of 100, until a total of 1000 parts were present in the simulation (Fig. 4). This approach enabled a direct comparison of system behaviour, responsiveness, and scalability between the ISG and EKS platforms under identical load conditions.

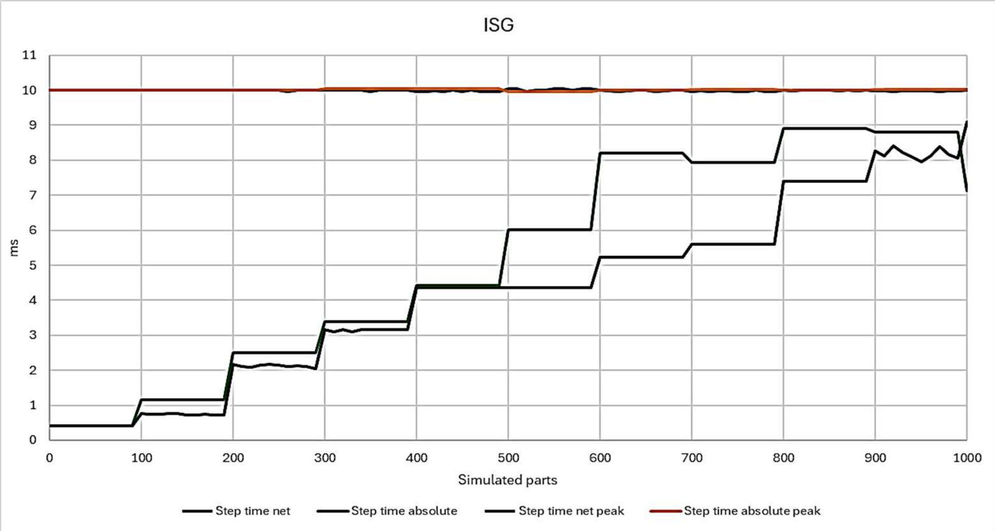

Fig. 4. ISG step time

Conclusions. The study revealed significant differences in simulation cycle time performance between the EKS and ISG platforms under varying load conditions. In the EKS environment, the baseline cycle time during idle operation and when no parts were being created ranged 18-25ms. However, when introducing parts, the cycle time increased substantially, peaking at 85m. The amount of production parts present in the simulation had no effect on the cycle time. This indicates a notable sensitivity to part creation, with performance degradation as the system load increased. In contrast, the ISG platform demonstrated significantly more efficient cycle time behaviour. The idle cycle time with no parts present was consistently below 1ms. After introducing the first batch of 100 parts, the cycle time rose to 1ms, and continued to increase gradually with each additional batch. At the maximum load of 1000 parts, the simulation maintained a cycle time of just 9ms. These results highlight ISG's superior scalability and responsiveness in high-volume, low-cycle-time production scenarios, making it a more suitable choice for complex digital twin and virtual commissioning applications where timing precision is critical. Both EKS and ISG Virtuos offer robust solutions for virtual commissioning and digital twin development. EKS stands out for its rapid deployment, integration efficiency, and training support, making it ideal for projects prioritizing speed and operational readiness. ISG Virtuos, with its advanced simulation capabilities and scalability, is better suited for complex, variant-heavy environments requiring deep modelling and multi-zone coordination.

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ПОРІВНЯННЯ СИСТЕМ ВІРТУАЛЬНОГО НАЛАШТУВАННЯ: EKS ПРОТИ ISG VIRTUOS

У цій статті представлено порівняльний аналіз двох провідних платформ для віртуального введення в експлуатацію та розробки цифрових двійників у промисловій автоматизації: EKS та ISG virtuos. Спираючись на нещодавній досвід проєктів та технічну документацію, у статті оцінюються обидві системи з погляду можливостей моделювання, інтеграції робочих процесів, масштабованості та практичного впровадження в автомобільному та виробничому середовищі. Їх використання в автомобільній промисловості дозволяє підвищити конкурентоспроможність та скоротити час розгортання робочих місць з реального середовища. Можливість мати цифрового двійника на додаток до реальної фізичної моделі лінії дозволяє вносити модифікації до лінії протягом її життєвого циклу відповідно до поточних потреб виробництва. Зважаючи на досвід використання цифрових двійників, а також використання обох платформ, можна стверджувати, що кожна з них знаходить своє застосування. Дослідження, проведене для порівняння продуктивності платформ моделювання від 100 до 1000 деталей, дозволило точно кількісно оцінити їх продуктивність та зосередитися на перевірці необхідних параметрів. На основі проведеного аналізу можна припустити, що використання ISG virtuos є вигіднішим у складніших системах завдяки більшій масштабованості. EKS є більш вигідною, коли необхідно реалізувати швидше розгортання, а команда, яка розробляє такого цифрового двійника, має менше досвіду в цій галузі. Водночас це дозволяє забезпечити кращу підтримку та обслуговування, ніж у випадку з платформою ISG virtuos. Тому вибір відповідної платформи для конкретного застосування повинен базуватися на пріоритетах та вимогах до створення конкретного віртуального середовища, а також на знаннях і досвіді розробників. Під час порівняння обох платформ на різних типах деталей можливо, що результати можуть відрізнятися, і тому цей факт необхідно враховувати.

Ключові слова: *віртуальне введення в експлуатацію; цифровий двійник; EKS; віртуози ISG; промислова автоматизація; моделювання.*

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