**“Edge computing-based real-time scheduling for digital twin flexible job shop with variable time window”**

Question 1:  
Doubt regarding the RS and PS Layer — where does it run? Does it run on the edge or fog?

Answer:  
The Real-Time Scheduling (RS) and Pre-Scheduling (PS) layers run on the edge server, not on fog or cloud. The edge server is physically located within the workshop, close to the machines and sensors. The PS layer generates initial schedules within a defined time window using algorithms such as the Improved Hungarian Algorithm, while the RS layer continuously updates and adjusts the schedule in real time according to actual shop-floor conditions. Keeping both layers at the edge ensures low latency, rapid responsiveness, and minimal communication delays — something that would not be possible if these layers ran on a fog node or in the cloud.

Question 2:  
According to Preethi, data filtering takes place in the edge server, and the cloud layer takes care of the virtual workshop. This contradicts what you just answered.

Answer:  
In the architecture described in the paper and presentation, both data filtering and the Virtual Workshop (VW) are localised at the edge, not in the cloud. Data from smart sensors and RFID readers is first filtered and preprocessed locally by edge devices, and then the edge server further processes and manages this information. This same edge server also hosts the VW, which functions as the digital twin of the physical workshop, running the real-time scheduling logic and maintaining the up-to-date state of the factory. The cloud layer in this design is reserved for tasks such as storing historical data, running large-scale analytics, or maintaining backups — but it does not manage the real-time VW. Any impression that the cloud “takes care” of the VW is therefore inconsistent with how this system is intended to operate.

Question 3:  
Difference between edge device and edge server.

Answer:  
An edge device is typically a small, dedicated piece of hardware such as a smart sensor, an actuator, or an RFID reader that collects raw production data and may perform light preprocessing at the source. These devices are located directly on or near the machines and have limited computing and storage capabilities. An edge server, on the other hand, is a more powerful computer or small on-site cluster installed within the workshop. It aggregates the data from multiple edge devices, carries out complex processing, runs algorithms such as PS and RS, and hosts the digital twin environment of the workshop. In short, edge devices feed raw or lightly processed data, while the edge server consolidates and uses that data for advanced, real-time operational decision-making.

Question 4:  
How is an edge server different from the fog layer?

Answer:  
An edge server is placed directly on the premises of a factory or workshop and is tightly coupled with the machinery and sensors. It is dedicated to serving that one physical site, providing ultra-low-latency responses and performing critical, time-sensitive functions such as real-time scheduling and digital twin simulation. A fog layer, in contrast, is a distributed computing layer that sits between the edge and the cloud, often serving a wider geographical area or multiple sites. It may manage aggregated data, coordinate workloads regionally, or provide redundancy and high-level optimisation — but it generally does not replace the ultra-fast, site-specific operations that an edge server performs. In the architecture we are discussing, there is no separate fog layer; all primary scheduling and virtual workshop functions happen directly on the edge server.

Question 5:  
If there is no fog, is this really scalable?

Answer:  
Yes, the system can still be scalable without a fog layer, depending on the intended deployment scope. An edge-only setup can scale effectively within a single site or even across multiple independent factories by adding more edge servers or enhancing the capacity of existing ones. For scenarios requiring cross-site coordination — such as balancing workloads among different facilities or sharing optimisation logic regionally — adding a fog layer could help improve scalability and efficiency without sacrificing latency as much as cloud-based processing would. The cloud can continue to play a complementary role in storing data, running historical analytics, and training predictive models. Thus, the absence of fog does not make the architecture unscalable for single-site real-time operations, though fog can be beneficial for large, interconnected deployments.