RESUME

Industrial & Systems Engineer (Ph.D.) | Simulation Solution Consultant | AI Solution Architect

JEHUN LEE

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Professional Profile

In the AI era, the most important question is not which model to use, but what problem is worth solving — defined through human will and necessity. Algorithms don't choose direction; people do.

My direction is to be a keyman: someone who sees the entire system, maps stakeholders, sets priorities, and deeply understands the problems that need solving so direction can be defined. The growth that lasts is the growth where the organization grows together — not where individuals optimize alone.

Systemic excellence, to me, means hiring AI agents — treating them as employees who execute autonomously, with humans setting direction and confirming key decisions. Chores, basic reviews, missing numbers move into agent pipelines, freeing human attention for the work only humans can do: judgment, strategy, meaning.

Education

2021.03 - 2025.02	**Ph.D. in Industrial & Systems Engineering**	Korea Advanced Institute of Science and Technology (KAIST)
2016.09 - 2021.02	**M.S. in Industrial Engineering**	Sungkyunkwan University (SKKU)
2013.03 - 2016.08	**B.S. in Systems Management Engineering**	Sungkyunkwan University (SKKU)
2011.03 - 2013.02	**High School in Math & Science Track**	Sejong Science High School

Work Experience

2025.08 - Present

Planning & Scheduling Solution Consultant
VMS Solutions Inc. | Solution Division | Consultant Part
Ministry of National Defense | Tech. Research Personnel [2025.08 - 2026.02]
System designer & PMO: digital twin platform, production-logistics integrated simulator, simulation-based AI scheduler, SaaS product
– SK Hynix Digital Twin Platform: production-logistics simulator PM, use-case discovery, KPI definition, data consistency metrics, MES legacy data analysis & simulator integration, AI prediction model data specification
– Production simulation engine architecture redesign & development participation
– Planned and authored 2 government R&D proposals on Agentic AI (manufacturing-specific Agentic AI, LLM-based production plan explanation module / with University of Toronto)
– AI extensibility review & design for simulation-based APS, new engine feature definition, participation in GenAI-based development
– LLM-based schedule analysis & report generation system performance review and feedback
– 2 SaaS solution consulting engagements; technical review supporting client executives' strategic decisions (general manufacturing, semiconductor back-end)

2025.02 - 2025.07

Planning & Scheduling Solution Consultant
VMS Solutions Inc. | Solution Division | Micron Part
Ministry of National Defense | Tech. Research Personnel [2025.02 - 2025.07]
Solution consultant: simulation-based real-time APS maintenance, system configuration remote support
– Micron global fab simulation-based real-time APS (advanced production and scheduling) system logic maintenance and remote system configuration support
– Production-logistics integrated simulation design

2021.03 - 2025.02

Researcher
KAIST | MSS (Manufacturing Service Systems) Lab.
Ministry of National Defense | Tech. Research Personnel [2023.03 - 2025.02]
Lead researcher: AI-based dynamic schedulers, optimization-based heuristics, autonomous manufacturing scheduling systems
– 9 industry-academia projects (planned 5, PM 4), 4 government projects (planned 3, PM 4)
– 2 SCI journal papers (1 first-author, 1 co-author), 11 international conference presentations (8 first-author, 3 co-author)
– Fundamental research on Neural Combinatorial Optimization based on GNN and RL
– Designed general-purpose scheduling agent and Meta-RL methodology for flexible adaptation to manufacturing environment changes
– Designed AI-based demand forecasting, production planning, and job scheduling optimization algorithms; validated business impact using real production data (Samsung Electronics, LG Electronics, Samsung Heavy Industries, etc.)
– Provided technical review supporting client executives' strategic decisions and delivered system design proposals

2016.04 - 2021.02

Researcher
SKKU | SCO (Systems Control & Optimization) Lab.
Scheduling algorithm developer: meta-heuristics, optimization; System designer: digital twin for manufacturing, dynamic rescheduling systems
– 5 industry-academia projects (planned 2, PM 2), 4 government projects (planned 2, PM 1)
– 3 SCI journal papers (1 first-author, 2 co-author), 10 international conference presentations (5 first-author, 5 co-author)
– Led foundational design and operations optimization research for 3D printer-based smart factory digital twin systems
– Developed rescheduling algorithms for handling disruptions (machine failures, order cancellations) in flexible manufacturing systems (FMS)
– Translated physical manufacturing constraints into mathematical models and validated in virtual environments
– Defined virtual factory operation scenarios and conducted simulation-based operational efficiency reviews

Projects

2026.02 - Present
4m
Digital twin platform construction: production-logistics simulation-based operation twin for semiconductor fab
VMS Solutions Inc. (with SK Hynix, SKT, SK AX, Calro)

2025.06 - 2025.12
7m
Digital twin platform construction: production-logistics simulation-based operation twin for semiconductor fab (PoC)
VMS Solutions Inc. (with SK Hynix, SKT, SK AX, Calro)

2025.03 - Present
16m
Software product design/development: simulation-based scheduling for semiconductor manufacturing
VMS Solutions Inc.

2025.02 - 2025.06
5m (5y)
Simulation-based real-time scheduler for semiconductor fab
VMS Solutions Inc. (with Micron)

2024.05 - 2025.02
10m (10y)
Autonomous scheduling for swift and efficient adaptation to dynamic manufacturing environments
KAIST (with NRF of Korea)

2024.03 - 2025.02
1y
AI-based algorithm for optimal operation plans for various scenarios
KAIST (with Samsung Electronics)

2023.07 - 2024.06
1y
Reinforcement learning for unrelated parallel machine scheduling problems with sequence-dependent setup times and machine eligibility
KAIST (with VMS Solutions)

2023.07 - 2024.02
8m
Production planning with AI
KAIST (with LG Electronics)

2022.05 - 2023.02
10m
Graph-based reinforcement learning algorithm for real-time job shop scheduling
KAIST (with NRF of Korea)

2022.04 - 2023.03
1y
Reinforcement learning for job shop scheduling
KAIST (with VMS Solutions)

2022.03 - 2022.03
1m (7m)
Development of a wiring optimization algorithm for X-DEC slim layout
KAIST (with SK Hynix)

2022.03 - 2025.02
3y
Reinforcement learning-based meta-scheduling for manufacturing systems
KAIST (with NRF of Korea)

2022.03 - 2023.07
1y5m (2y)
Reinforcement learning for project scheduling
KAIST (with Samsung Heavy Industries)

2021.07 - 2021.11
5m
Development of a reinforcement learning algorithm for workload balancing of ship cargo production
KAIST (with Samsung Heavy Industries)

2020.06 - 2021.02
9m
Optimal machine assignment with machine learning algorithms
SKKU (with VMS Solutions)

2019.06 - 2022.05
3y
Cyber-physical assembly and logistics systems in global supply chains
KAIST (with MOTIE of Korea, Yura)

2019.09 - 2020.02
6m
Optimal weight sets for dispatching rules with multiple KPIs
SKKU (with VMS Solutions)

2019.04 - 2019.12
9m (1y9m)
Big data-based simulation and optimization technology for smart manufacturing
SKKU (with MOTIE of Korea, Samsung SDI)

2019.03 - 2022.02
3y
Development of scheduling theory and algorithms with reinforcement learning for manufacturing systems
SKKU (with NRF of Korea)

2018.07 - 2018.09
3m
Methodology for dispatching rules' weights
SKKU (with SK Hynix)

2018.07 - 2019.02
8m
Framework development for KPI analysis with various weights on dispatching rules
SKKU (with VMS Solutions)

2017.07 - 2018.02
8m
Analysis of KPIs according to weights on dispatching rules for LCD manufacturing
SKKU (with VMS Solutions)

2017.07 - 2018.01
7m
Design and analysis for operations optimizations of smart factory testbed
SKKU (with MSIP of Korea)

2016.11 - 2019.10
3y
Development of scheduling and rescheduling algorithms for 3D printer-based smart factory
SKKU (with NRF of Korea)

2016.07 - 2017.02
8m
Development of algorithms for detecting and improving inefficient schedules in LCD processes
SKKU (with VMS Solutions)

2016.04 - 2018.05
2y2m (3y)
Development of open FaaS IoT service platform for mass personalization
SKKU (with MSIP of Korea)

Academic Works

2024 **Graph-based imitation learning for real-time job shop dispatcher** 1st Author
IEEE Transactions on Automation Science and Engineering [LINK]

2024 **Tree-based Dispatcher for Job Shop Scheduling** 1st Author
IEEE International Conference on Automation Science and Engineering (CASE)

2024 **Tree-based dispatcher for solving job shop scheduling problems** 1st Author
the Spring Conference of Korean Institute of Industrial Engineers

2023 **Active schedule-based imitation learning for job shop scheduling** 1st Author
the Spring Conference of Korean Institute of Industrial Engineers

2022 **Imitation learning for real-time job shop scheduling using graph-based representation** 1st Author
Winter Simulation Conference [LINK]

2022 **Job shop scheduling using graph-based imitation learning** 1st Author
INFORMS Annual Meeting

2022 **A multi-manned assembly line worker assignment and balancing problem with positional constraints** — Co-Author [LINK]
IEEE Robotics and Automation Letters

2022 **Reinforcement learning for resource leveling in multiple projects** — 1st Author
the Spring Conference of Korean Institute of Industrial Engineers

2022 **Dynamic job shop scheduling using graph-based imitation learning** — 1st Author
the Spring Conference of Korean Institute of Industrial Engineers

2021 **Machine learning-based periodic setup changes for semiconductor manufacturing machines** — 1st Author [LINK]
Winter Simulation Conference

2021 **Resource leveling in shipyard cargo hold process through reinforcement learning** — Co-Author
the Autumn Conference of Korean Institute of Industrial Engineers

2021 **Assembly line worker assignment and balancing problem with positional constraints** — Co-Author [LINK]
Advances in Production Management Systems (APMS)

2021 **Operation and optimization of the automotive parts assembly line considering worker skill levels** — Co-Author
the Summer Conference of Korea CDE

2020 **A sequential search method of dispatching rules for scheduling of LCD manufacturing systems** — 1st Author [LINK]
IEEE Transactions on Semiconductor Manufacturing

2020 **A simulation-based sequential search method for multi-objective scheduling problems of manufacturing systems** — 1st Author
Winter Simulation Conference

2020 **Workforce assignment for automotive parts assembly lines** — Co-Author
the Winter Conference of Korea CDE

2020 **Digital twin-based cyber physical production system architectural framework for personalized production** — Co-Author [LINK]
The International Journal of Advanced Manufacturing Technology

2020 **Workforce assignment with a different skill level for automotive parts assembly lines** — Co-Author [LINK]
Advances in Production Management Systems (APMS)

2019 **A sequential search framework for selecting weights of dispatching rules in manufacturing systems** — 1st Author [LINK]
Winter Simulation Conference

2019 **A genetic algorithm for hybrid flow shop scheduling with multiple assembly stages** — 1st Author
the Autumn Conference of Korean Institute of Industrial Engineers

2018 **Vulnerability analysis of evacuation transportation networks** — Co-Author
International Journal of Industrial Engineering-Theory Applications and Practice

2018 **A framework for performance analysis of dispatching rules in manufacturing systems** — 1st Author
Winter Simulation Conference

2018 **Rescheduling algorithms for 3D printer-based manufacturing systems** — 1st Author
the Summer Conference of Korea CDE

2018 **Scheduling algorithms for 3D printer-based manufacturing systems** — Co-Author
the Spring Conference of Korean Institute of Industrial Engineers

2017 **Rescheduling of flexible flow shop with sequence-dependent setup times and job splitting** — Co-Author [LINK]
Winter Simulation Conference

2017 **3D printer based assembly process scheduling algorithm development** — Co-Author
the Winter Conference of Korea CDE

Patents

2021.05.31 **Optimizing method for the manufacturing process** — South Korea KR1020210070359
A real-time optimization method for worker allocation in semi-automated assembly processes
Applicants: KAIST, Yura (entire 12 people)

Honors & Awards

2025.11	**Second Prize, Ph.D. Thesis Competition** $200 Learning Schedulers for Job Shop Scheduling Problems	Korean Institute of Industrial Engineers (KIIE)
2023.12	**First Prize, 2023 Simulation Challenge** $3,000 Q-time-based Gating Control in Semiconductor Fabrication	Winter Simulation Conference (WSC), Micron
2023.09	**Third Prize, 2023 AI Competition: Solving Real-world Problems** $1,500 Integrated Planning Module using AI	Hankook & Company
2022.06 - 2023.02	**Ph.D. Candidate Research Incentive Support** $15,000	NRF of Korea
2022.09	**Second Prize, 2022 Poster Competition: Industry/Social Problems** RL for Resource Leveling in Shipbuilding	KAIST
2022.05	**Certificate of Appreciation: Successful Project** Workload Balancing of Ship Cargo Production	Samsung Heavy Industries
2021.03 - 2025.02	**Full-tuition Entrance Scholarship** Full Tuition Merit-based Entrance Scholarship (Ph.D.)	KAIST
2019.03, 2019.09	**Graduate Assistant Tuition Waiver** Half Tuition Tuition Waiver (M.S. & Ph.D Integrated Program)	SKKU
2018.03, 2019.03	**Simsan Scholarship** Half Tuition Scholarship (M.S. & Ph.D Integrated Program)	SKKU
2018.03	**Systems & Management Engineering Scholarship** Half Tuition Scholarship (M.S. & Ph.D Integrated Program)	SKKU
2017.03	**Industrial Engineering Alumni Association Scholarship** Half Tuition Scholarship (M.S. & Ph.D Integrated Program)	SKKU
2016.07	**Third Prize, 2015-2016 PACE RSMS Competition (Second Year): Customer Insight**	General Motors (GM)
2016.07	**Third Prize, 2015-2016 PACE RSMS Competition (Second Year): Manufacturing Engineering**	General Motors (GM)
2013.03 - 2016.08	**Full-tuition Entrance Scholarship** Full Tuition Merit-based Entrance Scholarship (B.S.)	SKKU

Activities & Leadership

2022.03 - 2023.08	**Researcher Representative**	Manufacturing and Service Systems Lab. (KAIST)
2021.10 – 2021.12	**Technical Mentor**	Public Data Internship Program (Korea National Information Society Agency)
2021.03 – 2024.12	**Teaching Assistant (TA)**	Scheduling (KAIST)
2018.09 – 2019.06	**Teaching Assistant (TA)**	Supply Chain Management (SKKU)
2018.03 – 2019.02	**President**	Industrial Engineering Graduate Student Council (SKKU)
2018.03 – 2018.06	**Teaching Assistant (TA)**	Operations Management (SKKU)
2016.10 – 2018.12	**Teaching Assistant (TA)**	Gender Awareness Education (SKKU)
2017.09 – 2017.12	**Teaching Assistant (TA)**	Engineering Economy (SKKU)
2017.03 – 2017.06	**Teaching Assistant (TA)**	Operations Research and Practice 1 (SKKU)
2016.09 – 2016.12	**Teaching Assistant (TA)**	Engineering Economy (SKKU)
2015.03 – 2016.08	**Working Group Member**	Systems Management Engineering Student Council (SKKU)
2015.03 – 2016.08	**President**	Turbo: Basketball Club (SKKU)
2014.08 – 2020.02	**Working Group Member**	Turbo: Basketball Club (SKKU)
2013.03 – 2015.02	**Working Group Member**	College of Engineering Student Council (SKKU)
2012.03 - 2013.02	**Head of Student Autonomy Association**	Student Council (High School, 11th Grade)
2010.03 - 2011.02	**Vice President of Student Council**	Student Council (Middle School, 9th Grade)

Skills

Programming	Python, C#, SQL, LaTeX, R
Methodologies	Reinforcement Learning (RL), Imitation Learning (IL), Behavior Cloning (BC), Supervised Learning, Unsupervised Learning, Meta-heuristics, Graph Neural Networks (GNN), Combinatorial Optimization
Frameworks & Libraries	PyTorch, Matplotlib, Pandas, NumPy
Optimization Solvers	Gurobi, CPLEX, OR-Tools
Simulation & Tools	VMS Mozart (APS), Plant Sim, MS Office, Photoshop
DevOps & Productivity	Git / GitHub, Docker, Claude Code, n8n, Notion
Languages	Korean (Native), English (Professional)

Career Narrative

VMS Solutions Inc. (2025.02 - present) · Tech. Research Personnel 2025.02 - 2026.02

Digital twin platform construction: production-logistics simulation-based operation twin for semiconductor fab ★ PM

2026.02 - Present (4m) | SK Hynix | with SKT · SK AX · Calro

Background SK Hynix required an operation twin for autonomous fab realization, but lacked a unified production-logistics simulation framework to validate process twin consistency with real fab data

Objective Build a production-logistics integrated simulator and define process twin consistency validation framework

Role Production engine development PM

Key Activities
– Discovered real operation use-cases for the process twin through stakeholder interviews
– Production-logistics integrated simulator construction: modeling of process flows and material movement based on physical location on fab floor
– Operation log analysis and modeling for operation twin
– Integrated real semiconductor fab operational data and performed process twin consistency validation (MES data analysis, SQL)
– Defined simulation result consistency metrics and designed/developed automated computation pipeline
– WEB UI design participation and feedback

Outcomes Use-case discovery, KPI definition, consistency metrics definition, automated validation pipeline

Digital twin platform construction: production-logistics simulation-based operation twin for semiconductor fab (PoC) ★ PM

2025.06 - 2025.12 (7m) | SK Hynix | with SKT · SK AX · Calro

Background SK Hynix required an operation twin for autonomous fab realization, but lacked a unified production-logistics simulation framework to validate process twin consistency with real fab data

Objective Build a production-logistics integrated simulator and define process twin consistency validation framework

Role Production engine development PM

Key Activities
– Discovered and refined real operation use-cases for the process twin through stakeholder interviews
– Production-logistics collaborated simulator construction: modeling of process flows and material movement
– Integrated real semiconductor fab operational data and performed process twin consistency validation (MES data analysis, SQL)
– Defined simulation result consistency metrics
– WEB UI design participation and feedback

Outcomes Use-case discovery, KPI definition, consistency metrics definition, automated validation pipeline

Software product design/development: simulation-based scheduling for semiconductor manufacturing

2025.03 - Present (16m) | VMS Solutions

Objective Design and develop simulation-based scheduling product for semiconductor manufacturing

Role Solution consultant

Key Activities
– User scenario definition and data schema design
– AI dispatcher and optimization module integration design
– Production-logistics integrated scheduler logic design for semiconductor manufacturing, abstraction and generalization

Simulation-based real-time scheduler for semiconductor fab

2025.02 - 2025.06 (5m (5y)) | Micron

Background Micron's global semiconductor fabs required a next-generation real-time APS scheduler, but existing logic was tightly coupled to specific process constraints, limiting product generality across different fab configurations

Objective Design generalizable real-time scheduler logic by abstracting semiconductor process-specific constraints

Role Solution consultant

Key Activities
– Logic design and review for new real-time scheduler: equipment state changes, priority recalculation, and other core algorithm specification
– Abstracted semiconductor process-specific constraints (machine eligibility, batching rules) for improved product generality
– Remote solution environment configuration support

Outcomes Resolved Mozart environment issues; designed logic based on customer requirements

KAIST (2021.03 - 2025.02) · Tech. Research Personnel 2023.03 - 2025.02

Autonomous scheduling for swift and efficient adaptation to dynamic manufacturing environments ★ PM

2024.05 - 2025.02 (10m (10y)) | NRF of Korea

Background Existing AI-based schedulers required retraining for each new manufacturing environment. A 10-year NRF initiative was needed to develop autonomous scheduling that adapts to dynamic environments without environment-specific retraining

Objective Develop autonomous scheduling agents adaptable to diverse manufacturing environments; minimize makespan through GNN-based imitation learning for multi-process mixed-flow production

Role Planning, PM, Researcher

Key Activities

– Led 10-year project planning and execution
– Defined progressive extension cases with process constraints and multi-objective functions
– Year 1: Developed GNN-based imitation learning methodology for multi-process mixed-flow production that adapts to varying problem sizes

Outcomes Makespan optimal gap improved by 42.0% (vs. previous SOTA AI); 1 SCI journal paper (1st author)

AI-based algorithm for optimal operation plans for various scenarios

2024.03 - 2025.02 (1y) | Samsung Electronics

Background Samsung Electronics needed accurate demand forecasts for semiconductor products to optimize production planning, but existing methods lacked precision across diverse product categories

Objective Develop AI-based demand forecasting model achieving >80% accuracy across product segments

Role Problem definition, Researcher

Key Activities

– Identified decision-making processes through on-site engineer interviews
– Defined problem scope and resolution boundaries
– Data preprocessing and calibration
– Forecasting model conceptualization, discussion, and refinement
– Data segmentation

Outcomes Demand forecasting model accuracy: 89.3% / 80% / 80%

Reinforcement learning for unrelated parallel machine scheduling problems with sequence-dependent setup times and machine eligibility

2023.07 - 2024.06 (1y) | VMS Solutions

Background Real semiconductor manufacturing rarely matches clean academic scheduling assumptions — machines have eligibility restrictions, and setup times depend on operation order. Existing RL-based research had not directly tackled both constraints together on unrelated parallel machines (UPM).

Objective Design a GNN-based RL methodology for UPM scheduling that encodes machine eligibility and sequence-dependent setups directly in the state representation, and validate performance against established baselines.

Role Project planner and lead researcher — participated in proposal planning; designed the GNN-based RL methodology and performance evaluation framework.

Key Activities

– Formalized complex manufacturing constraints (eligibility, sequence-dependent setups, batching) into an RL-tractable form
– Designed a GNN state representation encoding both machine-operation eligibility and setup-time dependencies
– Trained and evaluated the RL agent across diverse instances; built the benchmark framework vs classical heuristics
– Consolidated findings into deliverables for VMS Solutions' semiconductor APS roadmap

Outcomes Delivered a GNN-RL methodology that natively handles machine eligibility and sequence-dependent setups — the first such direct treatment in this problem class. Results fed into VMS Solutions' simulation-based semiconductor scheduling product roadmap.

Notes Phase 2 of a two-year continuous VMS Solutions × KAIST research line. Phase 1 (project

Production planning with AI ★ PM

2023.07 - 2024.02 (8m) | LG Electronics

Background LG Electronics' refrigerator body assembly line suffered from excessive setup changes and low on-time production rates due to manual planning based on planner experience

Objective Minimize setup count, maximize on-time production rate, and maximize equipment utilization through optimization-based production planning

Role Planning, PM, Researcher

Key Activities

– Identified on-site constraints and defined problem through engineer interviews (objective: minimize setup count, maximize on-time production and equipment utilization)
– Data analysis and calibration (Excel → Python)

– Developed optimal production planning algorithm (optimization engine-based heuristic)
– Defined algorithm-based production planning process

Outcomes 7-day plan with 20min runtime limit: setup reduced 5.1%, on-time production improved 25.8%, idle time reduced 37.6% (vs. on-site manual plan)

Notes Achieved better results using optimization engine alone without deep learning

Graph-based reinforcement learning algorithm for real-time job shop scheduling ★ PM

2022.05 - 2023.02 (10m) | NRF of Korea

Background Real-time Job Shop scheduling requires graph-form representations of the changing process state and an RL methodology capable of making decisions under tight time budgets.

Objective Develop a graph-neural-network-based real-time Job Shop scheduling RL algorithm.

Role PM and lead researcher — drove proposal planning, GNN-based RL design, and the training framework.

Key Activities
– Built a high-fidelity simulator for Job Shop environments
– Designed the GNN-based state representation
– Trained and evaluated the imitation-learning-based RL dispatcher
– Discussed applicability to other manufacturing environments (battery, automotive, shipbuilding)

Outcomes Established the GNN-based imitation-learning dispatcher methodology. Foundation for the IEEE Transactions on Automation Science and Engineering first-author paper (2024).

Notes Core methodological building block for NRF Meta-Scheduling (#15) and the Hanwoomul project (#22).

Reinforcement learning for job shop scheduling ★ PM

2022.04 - 2023.03 (1y) | VMS Solutions

Background Existing Job Shop scheduling research used fragmented simulator-based evaluation, and the applicability of AI-based dispatching was limited.

Objective Enhance the Job Shop simulator, develop an AI-based dispatching methodology, and validate the applicability of imitation learning.

Role PM and lead researcher — drove proposal writing, simulator enhancement, and the AI-dispatching methodology.

Key Activities
– Enhanced the Job Shop simulator to reflect diverse constraints
– Designed and implemented an AI-based dispatching methodology
– Reviewed the applicability of imitation learning
– Fed findings back into the VMS Solutions product roadmap

Outcomes Established an AI-based Job Shop dispatching methodology. Resulted in the WSC 2022 first-author paper "Imitation Learning for Real-Time Job Shop Scheduling using Graph-based Representation".

Notes Phase 1 of a two-stage VMS Solutions × KAIST continuous research line. Phase 2 (#20, 2023.07 – 2024.06) extended to UPM with semiconductor-specific constraints.

Development of a wiring optimization algorithm for X-DEC slim layout

2022.03 - 2022.03 (1m (7m)) | SK Hynix

Background Wiring at the X-DEC Slim Layout stage of semiconductor memory cell design involves complex combinatorial constraints, but no formalized analytical methodology existed.

Objective Analyze the X-DEC Slim Layout wiring optimization problem from a combinatorial-optimization perspective and propose a methodology.

Role Researcher — responsible for constraint analysis and methodology discussion.

Key Activities
– Identified X-DEC Slim Layout wiring constraints through on-site engineer interviews
– Defined the problem and resolution scope
– Reviewed combinatorial-optimization-based methodologies and delivered technical recommendations

Outcomes Accumulated experience analyzing semiconductor memory-cell layout optimization through a combinatorial-optimization lens.

Notes Short (1-month) feasibility study — established future collaboration directions with SK Hynix.

Reinforcement learning-based meta-scheduling for manufacturing systems ★ PM

2022.03 - 2025.02 (3y) | NRF of Korea

Background Prior RL-based scheduling research locked each agent to a single problem setting — fixed plant size, fixed constraints, fixed objective. Reusing it under changing manufacturing environments required retraining from scratch.

Objective Establish a meta-scheduling methodology so a single agent adapts to manufacturing environments with dynamic problem sizes, constraints, and objectives — without retraining.

Role PM and principal investigator — designed the meta-learning methodology and unified dispatcher + look-ahead tree

search into a single scheduling framework.

Key Activities
– Designed a Meta-RL framework on graph-based state representations that generalizes across varying problem sizes and operation sequences
– Built a tree-based look-ahead search (SBBS) combining beam search with branch-and-bound for tight decision-time budgets
– Adopted an active-schedule-based RL training scheme to cut wasted search over dominated solutions
– Benchmarked against fixed-environment RL baselines and classical dispatching rules under environment-change scenarios

Outcomes SBBS was proved mathematically to always produce schedules equal to or better than dispatching-only solutions in static environments. The methodology generalized across problem sizes without retraining and formed the theoretical core of the doctoral thesis, awarded 2nd Prize at the KIIE Ph.D. Thesis Competition (2025.11).

Notes This NRF stream became the foundation for the 10-year "Hanwoomul" NRF project (#22), launched 2024.05, which extends the methodology toward autonomous scheduling in real factories.

Reinforcement learning for project scheduling

2022.03 - 2023.07 (1y5m (2y)) | Samsung Heavy Industries

Background Samsung Heavy Industries' 6-month shipbuilding schedule suffered from severe daily manpower fluctuations, causing inefficient resource utilization and increased labor costs

Objective Minimize daily worker employment deviation using RL-based schedule adjustment (objective: min std. dev. of daily manpower)

Role Planning, Researcher

Key Activities
– Led project planning and proposal writing
– Defined problem and resolution scope (objective: minimize daily worker employment deviation)
– Enhanced ship production simulator
– Enhanced RL-based schedule adjustment algorithm
– Proposed iterative greedy algorithm
– Discussed spatial layout algorithm methodology

Outcomes Year 1 schedule adjustment: daily manpower std. dev. reduced by 41.60% (RL, 20.27s), 44.53% (greedy, 49.86s), 47.69% (greedy+RL) vs. existing 6-month schedule

Development of a reinforcement learning algorithm for workload balancing of ship cargo production ★ PM

2021.07 - 2021.11 (5m) | Samsung Heavy Industries

Background Samsung Heavy Industries' ship cargo-hold production was scheduled manually by yard planners, with no quantitative load-balancing logic. Daily manpower demand swung between overloaded and idle days as a result.

Objective Build a ship-production simulator reflecting real yard constraints and design a reinforcement-learning algorithm that minimizes the standard deviation of daily manpower demand.

Role Project planner, PM, and lead researcher — drove proposal writing, problem definition, and algorithm development end-to-end.

Key Activities
– Modeled cargo-hold production constraints through shipyard engineer interviews
– Designed a project-based ship-production simulator reflecting real yard operations
– Compared three algorithms — pure RL, pure Greedy, and a Greedy+RL hybrid
– Benchmarked performance against the baseline 6-month schedule and analyzed convergence speed

Outcomes Daily manpower standard deviation dropped vs the baseline schedule — RL 41.60% (20.27 s), Greedy 44.53% (49.86 s), Greedy+RL 47.69%. RL converged ~2.4× faster than iterative heuristics. Won Samsung Heavy Industries Certificate of Appreciation (2022.05) and 2nd Prize at the KAIST IE Poster Competition (2022.09).

Notes Phase 1 of a two-stage Samsung Heavy Industries research line. Phase 2 (project

Cyber-physical assembly and logistics systems in global supply chains ★ PM

2019.06 - 2022.05 (3y) | MOTIE of Korea, Yura

Background In a EUREKA international collaboration (Korea-Sweden), automotive parts assembly required real-time worker allocation optimization to reduce cycle time in semi-automated production lines with varying worker skill levels

Objective Minimize cycle time through real-time worker allocation and conveyor speed optimization in automotive assembly

Role Planning, PM, Researcher (global project part lead)

Key Activities
– Identified on-site constraints through field interviews
– Defined problem and resolution scope
– Developed automotive parts production simulator and real-time worker allocation/reallocation algorithm
– Developed conveyor belt speed determination algorithm for semi-automated assembly processes
– Defined user scenarios and program screen specifications

Outcomes Cycle time reduced 5.6% (real on-site data, actual operation method) / 2-5% (vs. meta-heuristic algorithm); Patent registered: KR1020210070359; 1 SCI journal paper (2nd author); 2 conference papers

SKKU (2016.04 - 2021.02)

Optimal machine assignment with machine learning algorithms ★ PM

2020.06 - 2021.02 (9m) | VMS Solutions

Background Pure dispatching-rule-based scheduling reached a ceiling — machine-learning-based prediction was needed to supplement decision quality, particularly around setup-change behavior.

Objective Develop an ML-based machine-assignment algorithm that uses prediction models to optimize equipment allocation decisions.

Role PM and lead researcher — drove design of the AI prediction model and the machine-assignment algorithm.

Key Activities
– Analyzed setup-change patterns in semiconductor equipment
– Designed and trained an ML-based setup-change prediction model
– Built a machine-assignment algorithm that consumes the prediction output
– Validated performance via simulation-based benchmarking

Outcomes Implemented an AI-prediction-driven optimal machine-assignment algorithm. Foundation of the WSC 2021 first-author paper "Machine Learning-based Periodic Setup Changes for Semiconductor Manufacturing Machines".

Notes First transition from rule-based scheduling to ML-driven decision-making in this research line.

Optimal weight sets for dispatching rules with multiple KPIs ★ PM

2019.09 - 2020.02 (6m) | VMS Solutions

Background Dispatching-rule-based scheduling was typically evaluated against a single KPI, yet real operations demand simultaneous consideration of makespan, tardiness, and setup count.

Objective Design a Sequential Search framework that derives optimal dispatching-rule weights while considering multiple KPIs simultaneously.

Role PM and lead researcher — drove the multi-objective extension methodology.

Key Activities
– Defined the multi-KPI hierarchy and priority structure
– Extended the Sequential Search framework to multi-objective settings
– Ran simulations across diverse weight scenarios and analyzed results
– Consolidated outputs for VMS Solutions product integration

Outcomes Completed the multi-objective Sequential Search framework. Resulted in the WSC 2020 first-author paper "A Simulation-based Sequential Search Method for Multi-objective Scheduling Problems" — culminating the dispatching-rule research line with the IEEE TSM 2020 first-author publication.

Notes Final stage of the VMS Solutions dispatching-rule research line (2016.07 – 2020.02).

Big data-based simulation and optimization technology for smart manufacturing

2019.04 - 2019.12 (9m (1y9m)) | MOTIE of Korea, Samsung SDI

Background Samsung SDI battery production generated large volumes of noisy operational data, but lacked a simulation-based framework for real-time scheduling decisions.

Objective Build a battery-production simulator and design a real-time scheduling framework that reflects process-specific constraints.

Role Researcher — responsible for battery process simulator and scheduling algorithm design.

Key Activities
– Identified battery production constraints through on-site engineer interviews
– Built a battery production simulator and defined the resolution scope
– Designed scheduling algorithms reflecting process-specific characteristics
– Defined MES-integration data schema for the production operations system

Outcomes Established a simulation-based framework that supports real-time decision-making under large, noisy production data. Built collaborative experience with Micube Solution, Samsung SDI, and KITECH.

Notes MOTIE government project — partners: Micube Solution, Samsung SDI, KITECH.

Development of scheduling theory and algorithms with reinforcement learning for manufacturing systems

2019.03 - 2022.02 (3y) | NRF of Korea

Background Research on applying RL to manufacturing scheduling was growing, but the field lacked a high-fidelity Job Shop simulator and a systematic training framework.

Objective Establish foundational research on RL-based scheduling theory and algorithms for manufacturing systems.

Role Researcher — participated in proposal planning; built the Job Shop simulator and designed the RL-based scheduling methodology.

Key Activities
– Built a high-fidelity simulator for Job Shop environments
– Designed and implemented an RL-based scheduling methodology

– Discussed applicability to other manufacturing environments (battery, automotive, shipbuilding)
– Wrote academic papers and presented at domestic and international conferences

Outcomes Secured foundational know-how on RL-based scheduling. Foundation for the WSC 2022 first-author paper "Imitation Learning for Real-Time Job Shop Scheduling using Graph-based Representation".

Notes Starting point of the doctoral research thread that later led to NRF Meta-Scheduling (#15) and the Hanwoomul project (#22).

Methodology for dispatching rules' weights ★ PM

2018.07 - 2018.09 (3m) | SK Hynix

Background SK Hynix's semiconductor FAB lines operate with multiple dispatching rules acting in combination, making single-KPI optimization of weights impractical in field conditions.

Objective Apply the sequential-search dispatching-weight methodology to a real semiconductor FAB and validate operational gains.

Role PM and lead researcher — drove on-site constraint analysis, algorithm application, and validation.

Key Activities
– Identified FAB-line constraints through on-site engineer interviews
– Analyzed correlations among multiple dispatching rules
– Applied the Sequential Search framework to the SK Hynix FAB environment
– Consolidated validation results and identified follow-up research directions

Outcomes Demonstrated that the Sequential Search methodology — developed in the VMS Solutions × SKKU research thread — applies to real semiconductor FAB environments.

Notes Linked to

Framework development for KPI analysis with various weights on dispatching rules ★ PM

2018.07 - 2019.02 (8m) | VMS Solutions

Background Dispatching-rule-based scheduling was typically evaluated against a single KPI, making it hard to optimize across multiple operational indicators simultaneously.

Objective Develop a framework that quantitatively analyzes KPI changes across dispatching-rule weight configurations.

Role PM and lead researcher — drove framework design and ML-based weight optimization.

Key Activities
– Designed a KPI-change analysis framework keyed on dispatching-rule weight perturbations
– Built an ML-based algorithm for deriving optimal weight configurations
– Built a simulation-based validation environment for repeatable benchmarking
– Implemented demo application (C#, WinForm) for product integration

Outcomes Established a framework that quantitatively evaluates and derives dispatching-rule weights. Foundation for the WSC 2019 first-author paper.

Notes Part of the VMS Solutions multi-year industrial research series — later evolved into the Sequential Search methodology.

Analysis of KPIs according to weights on dispatching rules for LCD manufacturing

2017.07 - 2018.02 (8m) | VMS Solutions

Background LCD manufacturing applied multiple dispatching rules in combination, yet no quantitative analysis existed on how weight changes propagated into KPIs.

Objective Build a framework that analyzes performance changes induced by dispatching-rule weight configurations in LCD processes.

Role Researcher — designed and implemented the simulation-based performance analysis framework.

Key Activities
– Analyzed LCD process characteristics and organized the dispatching-rule matrix
– Built a simulation-based performance-comparison environment
– Analyzed and visualized weight-KPI correlations

Outcomes Established a performance-analysis framework keyed on dispatching-rule weight changes. Foundation for the WSC 2018 first-author paper "A Framework for Performance Analysis of Dispatching Rules".

Design and analysis for operations optimizations of smart factory testbed

2017.07 - 2018.01 (7m) | MSIP of Korea

Background A government-funded smart factory testbed had been built, but lacked a simulation environment to quantitatively validate operational efficiency under varying scenarios.

Objective Build a virtual factory simulator and analyze operational efficiency across scenarios.

Role Researcher — responsible for simulator construction and scenario analysis.

Key Activities
– Defined virtual-factory operation scenarios and built the simulator
– Conducted simulation-based operational efficiency analysis
– Consolidated findings and identified follow-up research directions

Outcomes Established a methodology for validating operational efficiency through simulation.

Notes Linked to

Development of scheduling and rescheduling algorithms for 3D printer-based smart factory

2016.11 - 2019.10 (3y) | NRF of Korea

Background 3D-printer-based flexible manufacturing systems (FMS) are central to mass personalization, yet lacked real-time rescheduling mechanisms to handle disruptions like machine failure, order cancellation, and rush orders.

Objective Develop scheduling and rescheduling algorithms tailored to 3D-printer-based FMS characteristics.

Role Researcher — analyzed FMS characteristics and built the rescheduling algorithms.

Key Activities

– Analyzed characteristics of 3D-printer-based flexible manufacturing systems
– Defined disruption scenarios — machine failure, order cancellation, rush orders
– Developed rescheduling algorithms for disruption response
– Designed real-time schedule derivation using genetic algorithms and heuristics, and validated performance

Outcomes Built a rescheduling mechanism that responds in real time to machine state and order changes. Resulted in a 2nd-author publication in Int. Journal of Advanced Manufacturing Technology (2020).

Notes Mass Personalization research line — connected to the MSIP FaaS IoT platform project (#1).

Development of algorithms for detecting and improving inefficient schedules in LCD processes

2016.07 - 2017.02 (8m) | VMS Solutions

Background Inefficient schedule patterns were accumulating in VMS Solutions' LCD operational data, yet no automated detection or improvement mechanism existed.

Objective Design heuristic algorithms that detect inefficient LCD schedules and improve them.

Role Researcher — responsible for pattern analysis and heuristic algorithm design and implementation.

Key Activities

– Identified inefficient schedule patterns through LCD operational data analysis
– Defined inefficiency-detection metrics and automated their validation
– Designed and implemented heuristic improvement algorithms

Outcomes First industrial research engagement with VMS Solutions — established the starting point of the multi-year dispatching-rule research line.

Development of open FaaS IoT service platform for mass personalization

2016.04 - 2018.05 (2y2m (3y)) | MSIP of Korea

Background Mass-personalization production requires integrated control of distributed, heterogeneous equipment — 3D printers, robotic handlers, IoT sensors — but no unified platform existed for such an environment.

Objective Build an IoT service platform that integrates heterogeneous equipment under the Factory-as-a-Service (FaaS) concept.

Role Researcher — responsible for the 3D-printer Urban Factory scheduling simulator and algorithm development.

Key Activities

– Built the 3D-printer Urban Factory scheduling simulator and the initial scheduling algorithm
– Developed rescheduling algorithms for disruption response
– Reviewed robot-handler operation algorithms
– Defined data schema and supported integration of the scheduling algorithm into the product

Outcomes Accumulated experience operating a large multi-institution government project that integrated distributed heterogeneous equipment under FaaS principles.

Notes Partners: SKKU, ETRI, Yonsei University, HyVISIONsystem, CoeverI&T, PartDB, LatisGlobal Communications.