

Some Recent Thoughts on IAHM&MSG-4

-Quantitative Hypotheses of MSG Methodology

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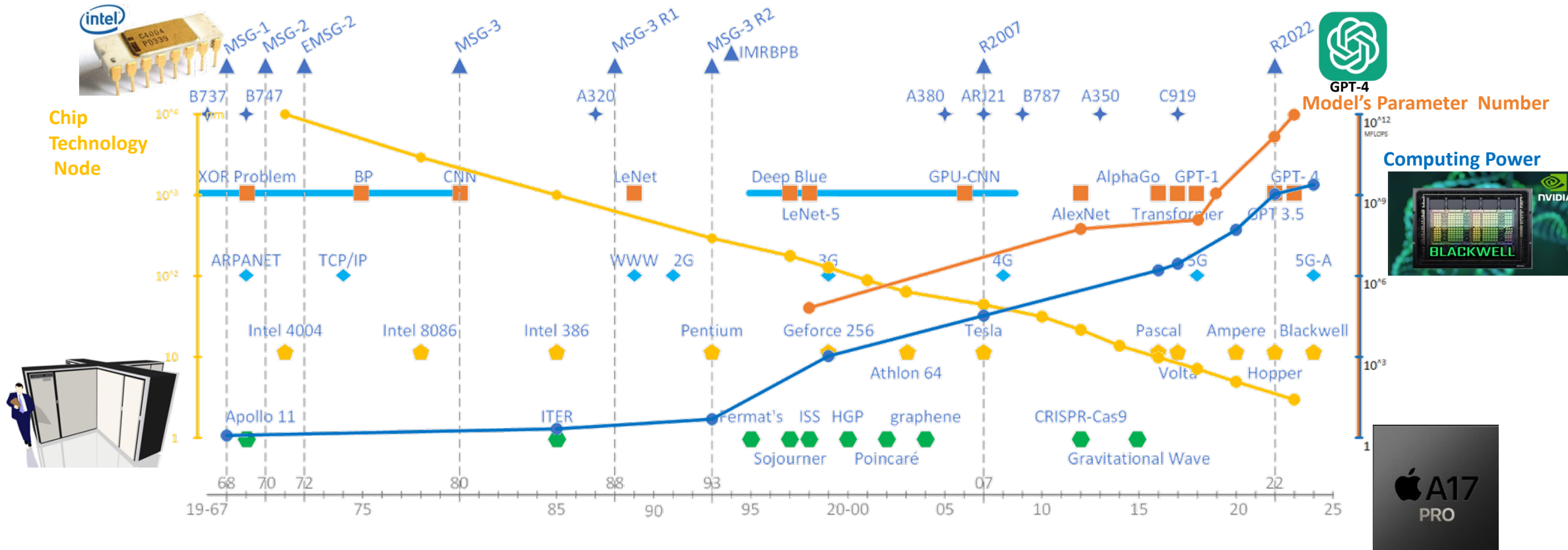
May 13-18, 2024

IMRBPB Annual Meeting



What Inspires Our Thoughts

- The difficulties & pains encountered, the experience and knowledge gained on our projects.
- Thoughts from the perspective of technological evolution history.





Quantitative Hypotheses of MSG Methodology



How to Quantization?----Reliability Centered Quantization

- ➔ MSG-3 is a reliability centered methodology.
- ➔ However, except for the system module, the concept of reliability is only used in a very obscure way in the analysis processes of structure/zonal/LHIRF.
- ➔ Even within the system module, reliability concepts and data are not thoroughly studied and utilized.



Quantitative Hypotheses of MSG Methodology



Reliability Centered Quantization ---- Structure

Current structural analysis logic:

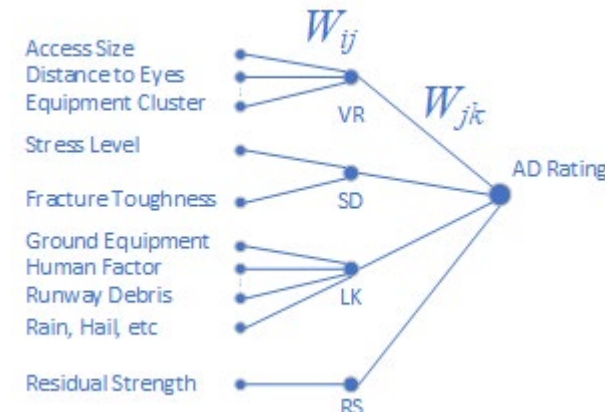
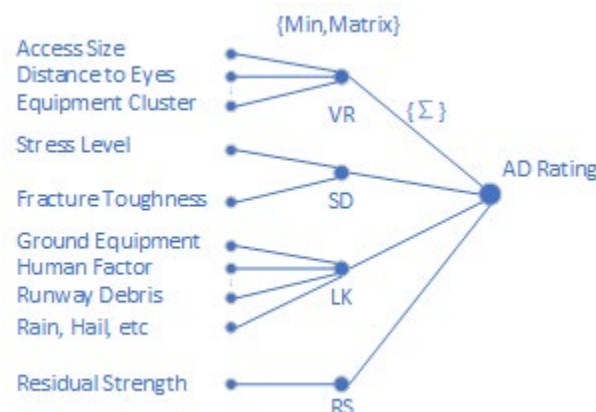
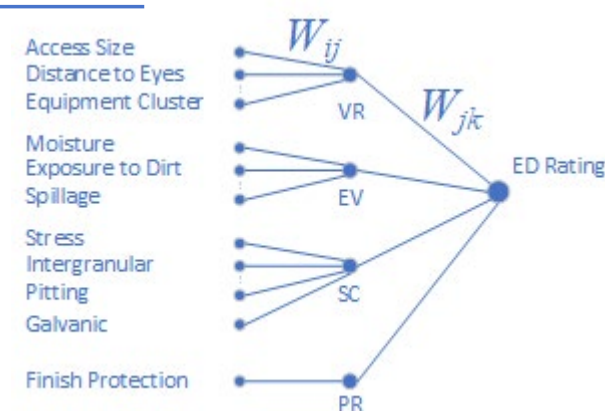
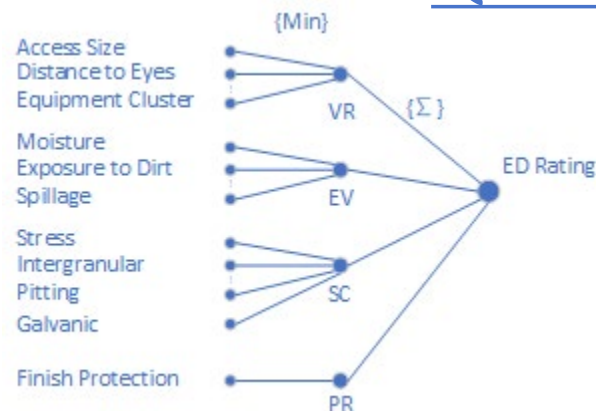
But:

- Are initial ratings based on experience accurate enough?
- The most severe factor penalizes all factors.
- All factors have equal weight.

Quantization:

Assign corresponding weights to the impact of each factor on EA/AD, and then, driven by aircraft in-service data, learn these weights through technical means such as machine learning or AI learning algorithms.

Quantization

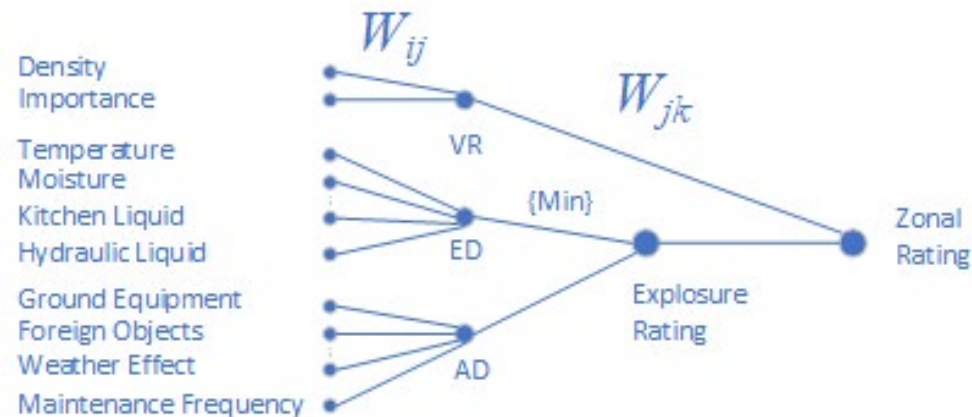
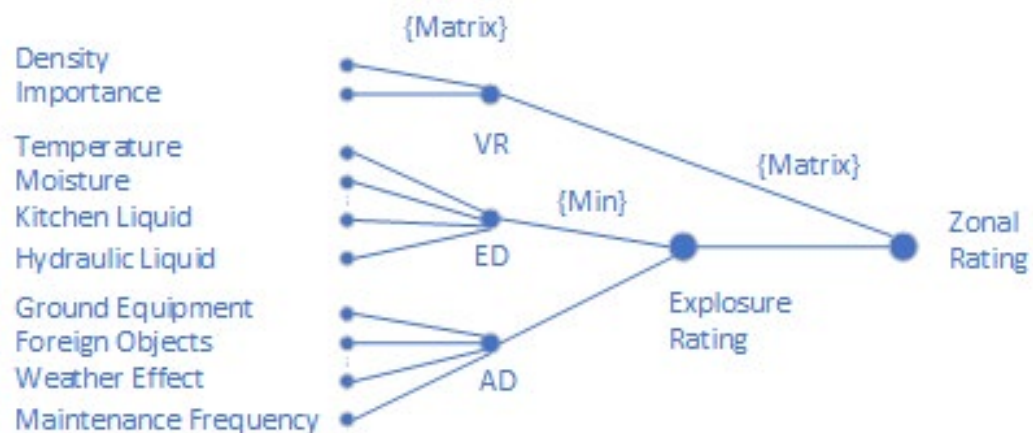




Quantitative Hypotheses of MSG Methodology

Reliability Centered Quantization ---- Zonal

Quantization

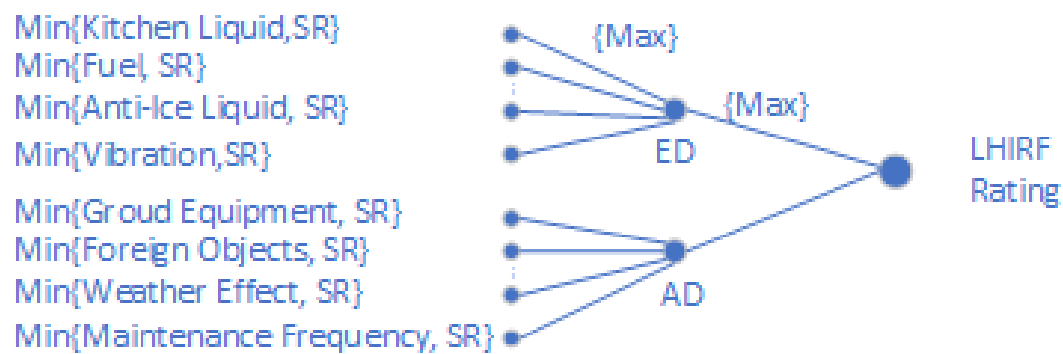




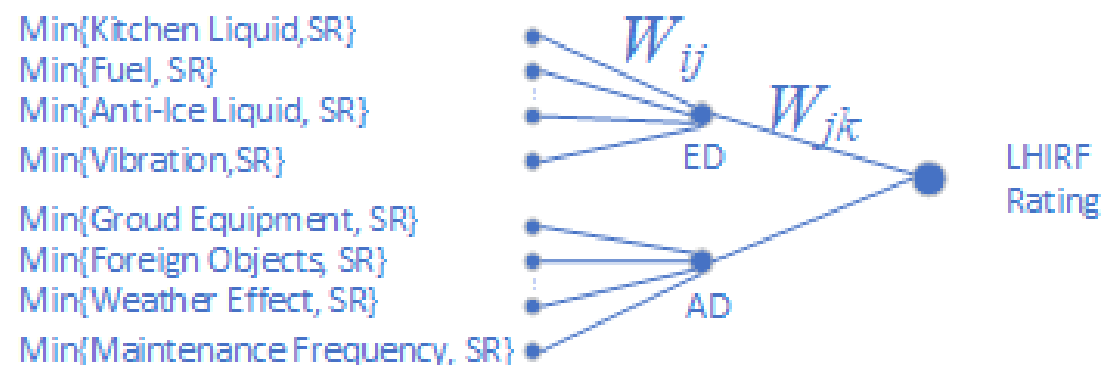
Quantitative Hypotheses of MSG Methodology

Reliability Centered Quantization ---- L/HIRF

Quantization



* SR= Susceptibility Rating





Quantitative Hypotheses of MSG Methodology

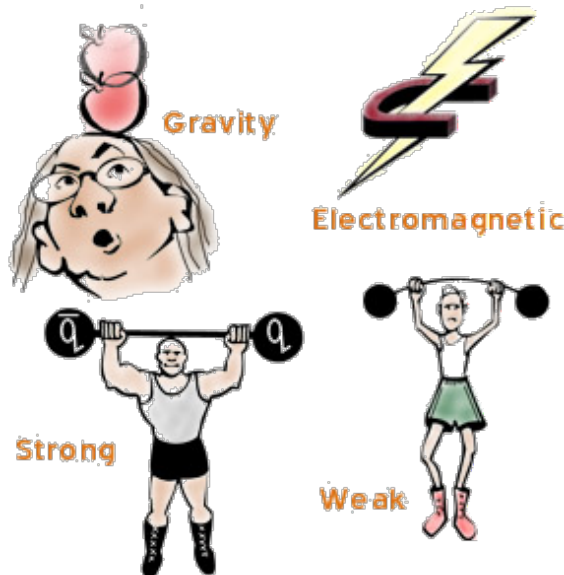
Reliability Centered Quantization

System: {MTBF, MTBUR}
Structure: {AD Rating, ED Rating}
Zonal: {Zonal Rating}
L/HIRF: {L/HIRF Rating}

Functions/Models



System Reliability
Structural Reliability
Zonal Reliability
L/HIRF Reliability



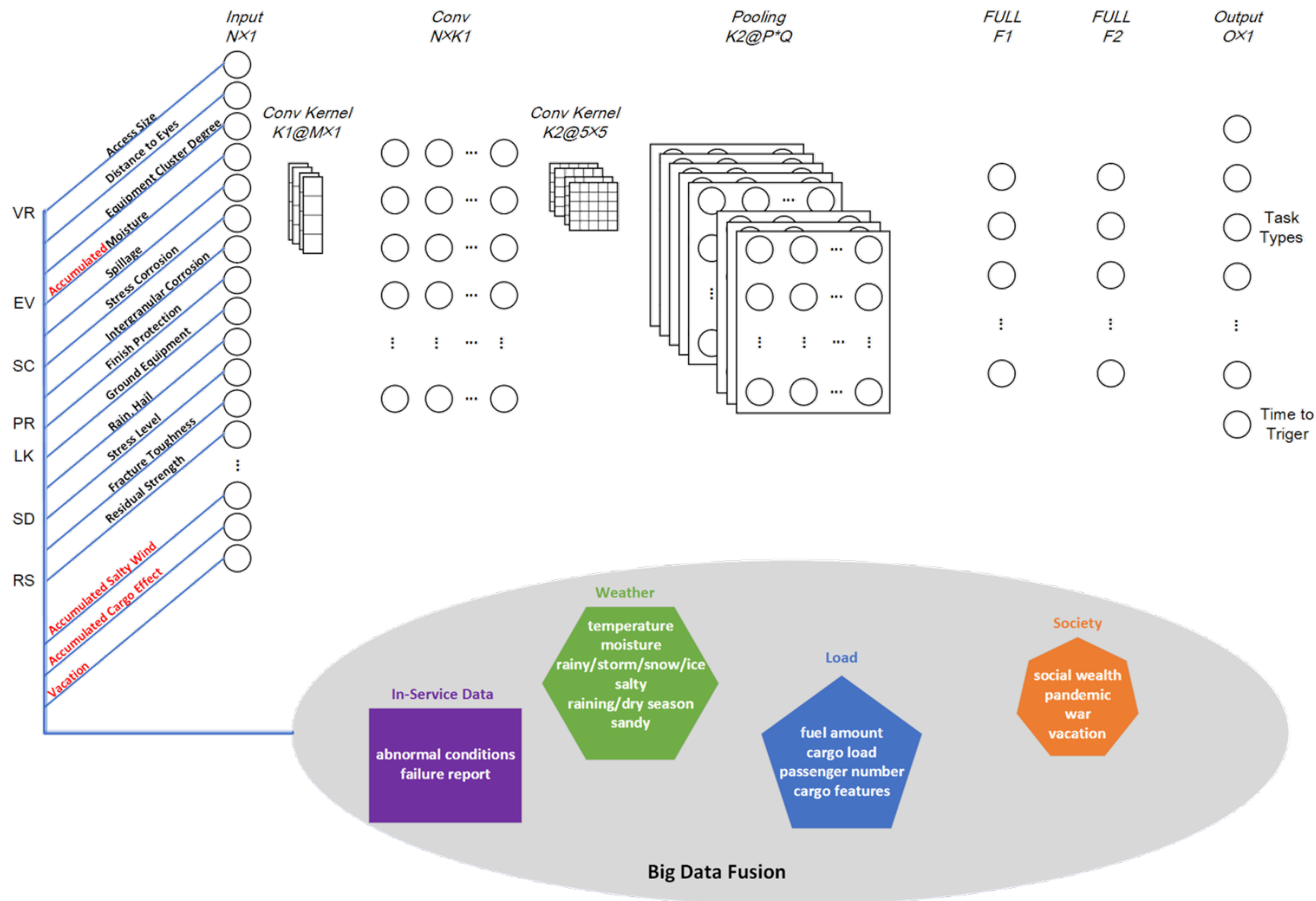
Four Fundamental Forces in physics



Quantitative Hypotheses of MSG Methodology

Prototype Model Design for MSG

Sensitivity to Damage		Stress Level		
		0	1	2
Fracture Toughness	0	0	1	1
	1	1	1	2
	2	1	2	2
Sensitivity to Damage (SD)		1		





Quantitative Hypotheses of MSG Methodology



Future Work Plan

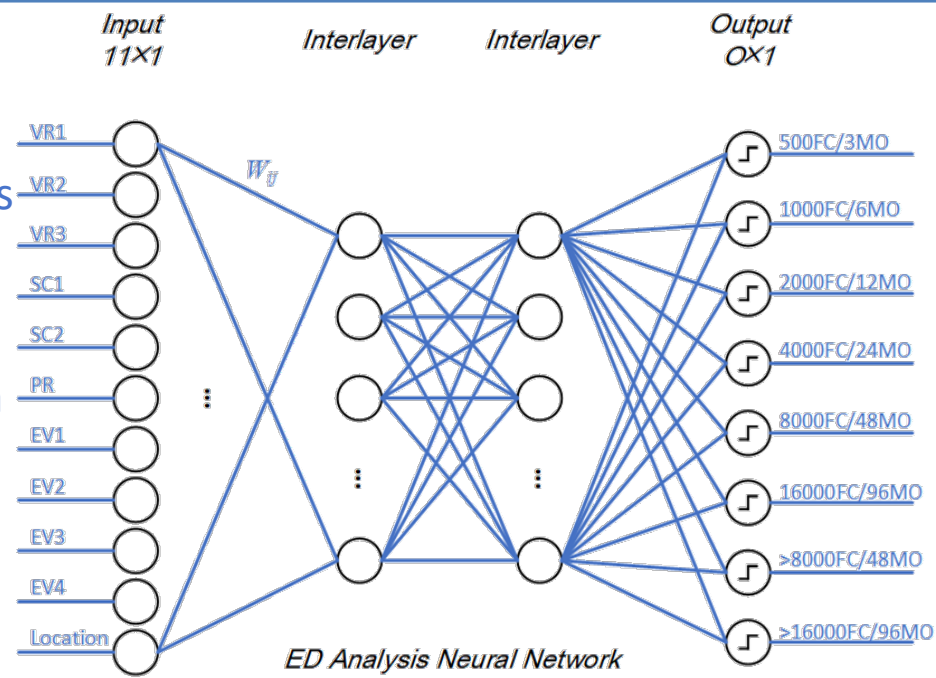
Phase I Build Simple Neural Network Model with Integer Input 3-4 months

SSI No. 53-30-01	VR			SC		PR		EV				SD		RS	LK								EDR	ADR	ED Interval	AD Interval
From SD229.000 to SD560.722, Stringer 1 to 11, fuselage	VR1	VR2	VR3	SC1	SC2	PR	EV1	EV2	EV3	EV4	SD1	SD2	RS	LK1	LK2	LK3	LK4	LK5	LK6	LK7	LK8					
skin	2	2	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	7	8	16000FC/96MO	16000FC/96MO	
stringer	2	2	1	2	0	2	2	1	2	2	2	1	2	2	2	2	2	2	2	2	2	6	7	16000FC/96MO	16000FC/96MO	
stringer fitting	2	2	1	2	1	2	2	1	2	2	2	1	2	2	2	2	2	2	2	2	2	7	7	16000FC/96MO	16000FC/96MO	
cutout doubler	1	2	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	7	7	16000FC/96MO	16000FC/96MO	

Phase II Build Simple Neural Network Model with Real Input 2 months

Phase III Design Learning Algorithm for the Simple Neural Network Model Using In-Service Data 3-4 months

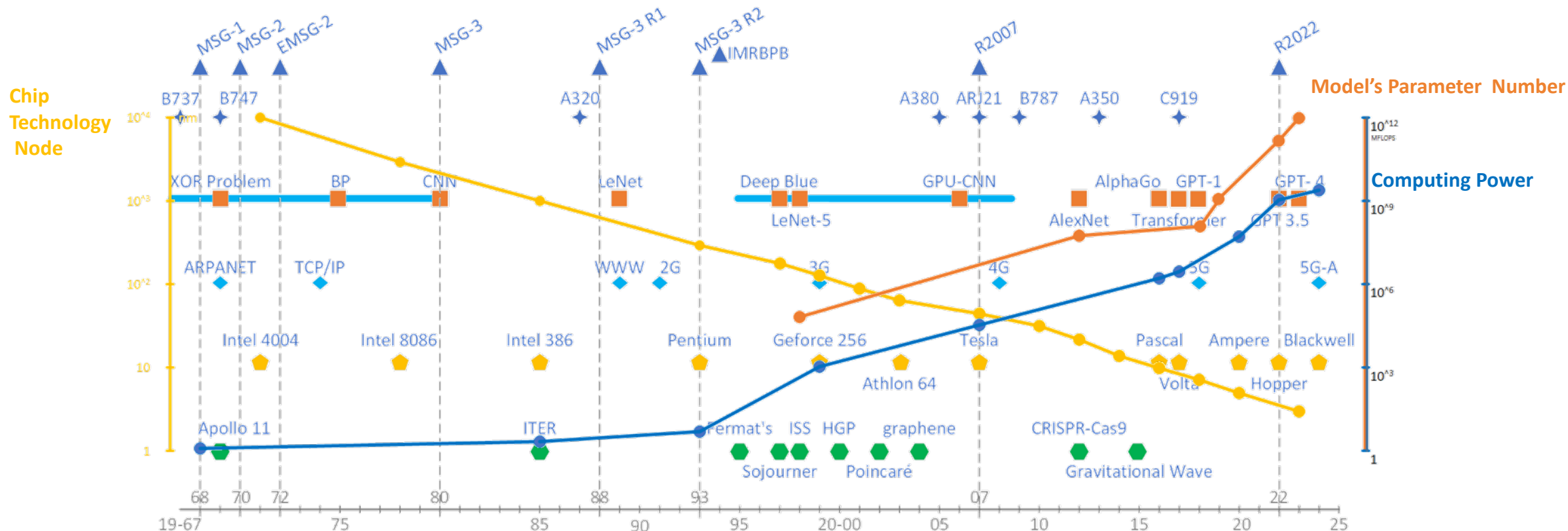
Phase IV Exploring Complex Neural Network Models with Big Data Fusion Long Term





Quantitative Hypotheses of MSG Methodology

Conclusion ---- Understanding the History



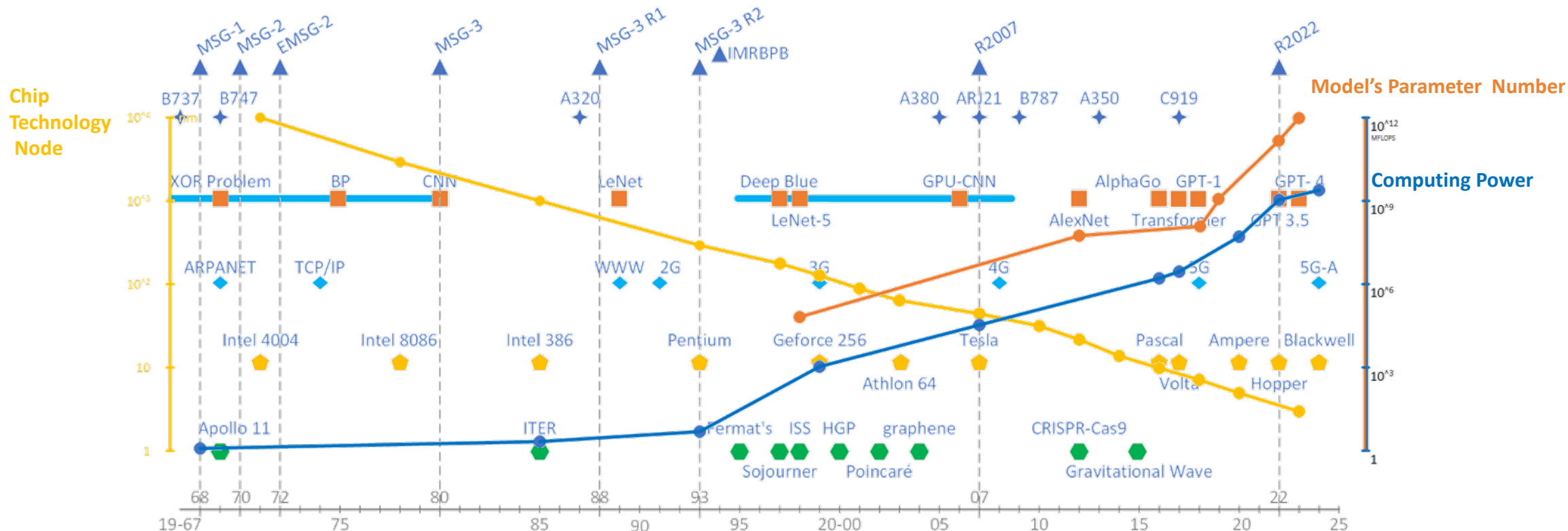
- Computing power is so limited
- AI technology is still in its early stages
- B747 is an industry miracle

- Top-down method
- Qualitative analysis
- Level 1&2 architecture and questions
- One MRBR for all aircrafts



Quantitative Hypotheses of MSG Methodology

Conclusion ---- Rooting in the Present



- An age of rapidly increasing computing power
- An age of AI booming
- An age of transforming knowledge and experience into models and algorithms
- Fourth Industrial Revolution is coming (artificial intelligence, nanotechnology, quantum computing, biotechnology, fusion power, room-temperature superconductor)

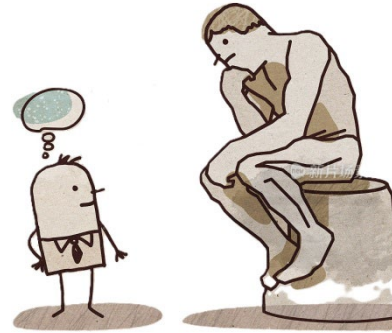


Quantitative Hypotheses of MSG Methodology

Conclusion ---- Exploring the Future



MSG-3



MSG-4

Paradigm Shifting

Qualitative analysis

VS

Quantitative analysis

Logic/Task/Interval

VS

Data/Model/Algorithm

One MRBR for All aircrafts

VS

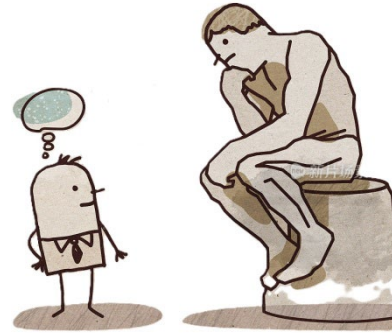
Each item is monitored individually



Quantitative Hypotheses of MSG Methodology



Conclusion ---- Exploring the Future



Getting Prepared!

Personnel: Requires more skills at data processing/modeling/AI algorithms/programming

Data: Data acquisition /storage/transfer/processing| |Need industry standards

Determination Is All We Need

Attention Is All You Need

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The background of the slide is a wide-angle photograph of a long, multi-lane bridge stretching across a vast body of water towards a distant horizon. The sky is filled with soft, colorful clouds in shades of blue, orange, and pink, suggesting a sunset or sunrise. The bridge's structure is visible, including its supports and a cable-stayed section in the foreground.

Thank You

Any questions, please ping wangyiping@comac.cc