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Transitioning LS-Dyna workloads to the Cloud in the path to Digital Maturity

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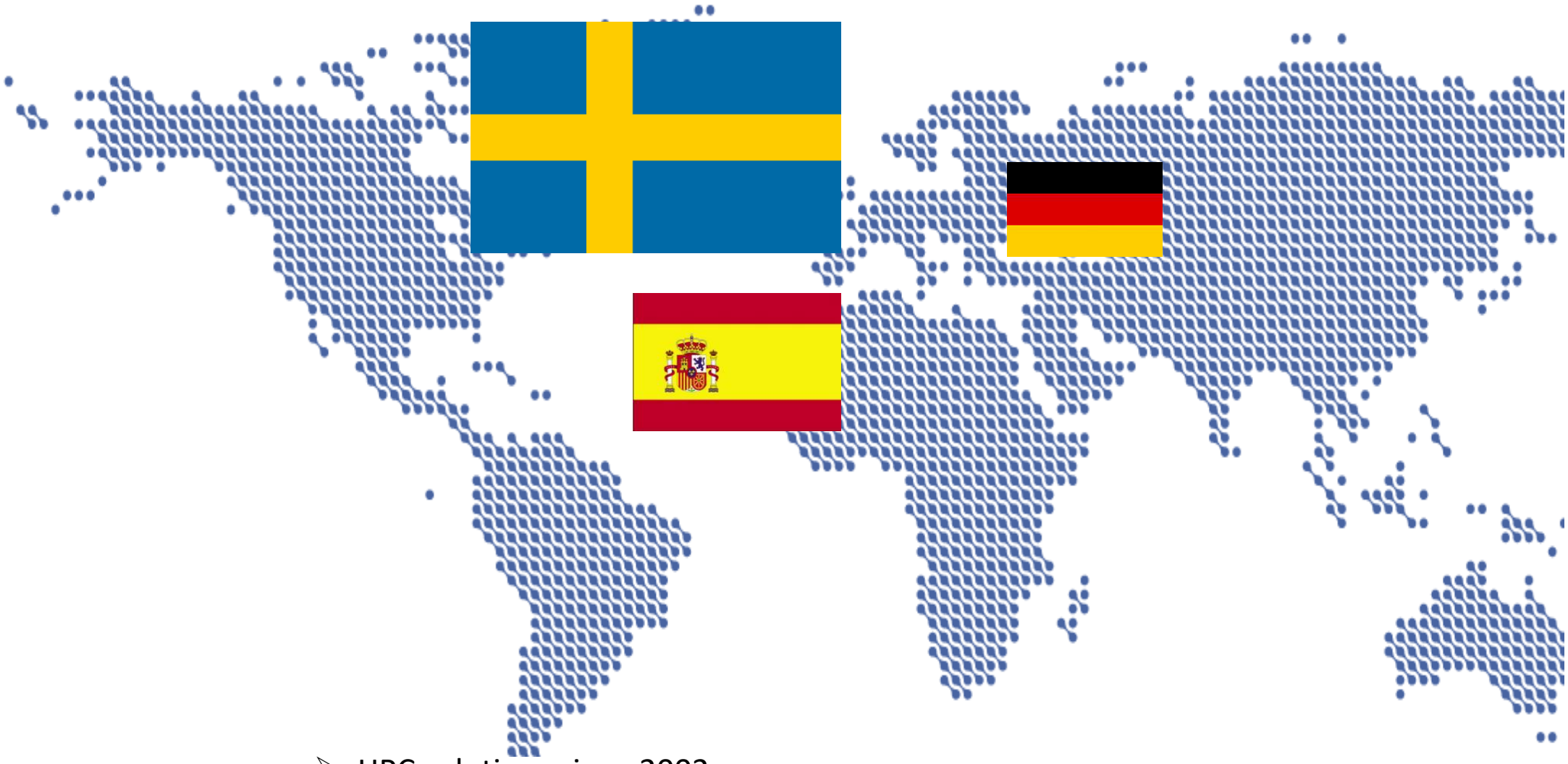
About Gompute



- HPC solutions since 2002
- CAE customers
- Multiple industries: Marine, automotive, energy, manufacturing…

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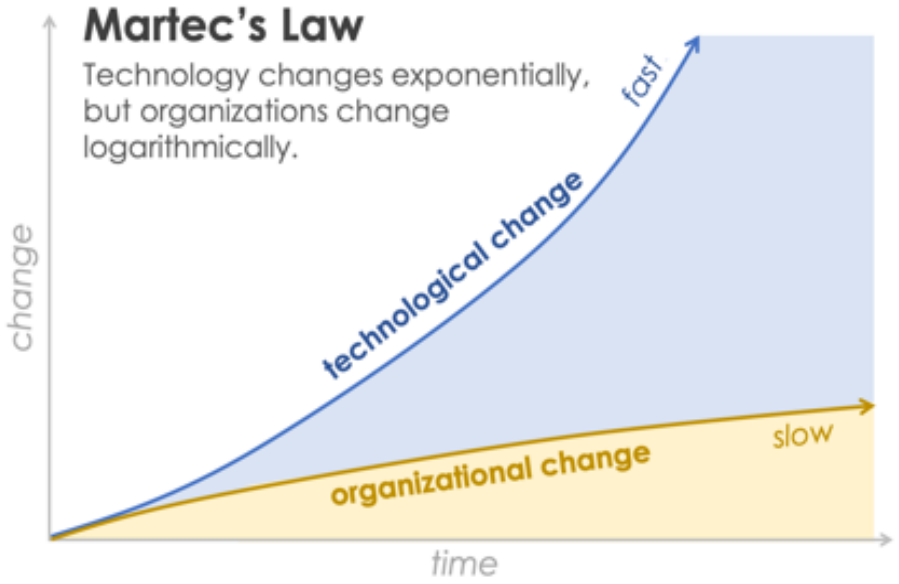
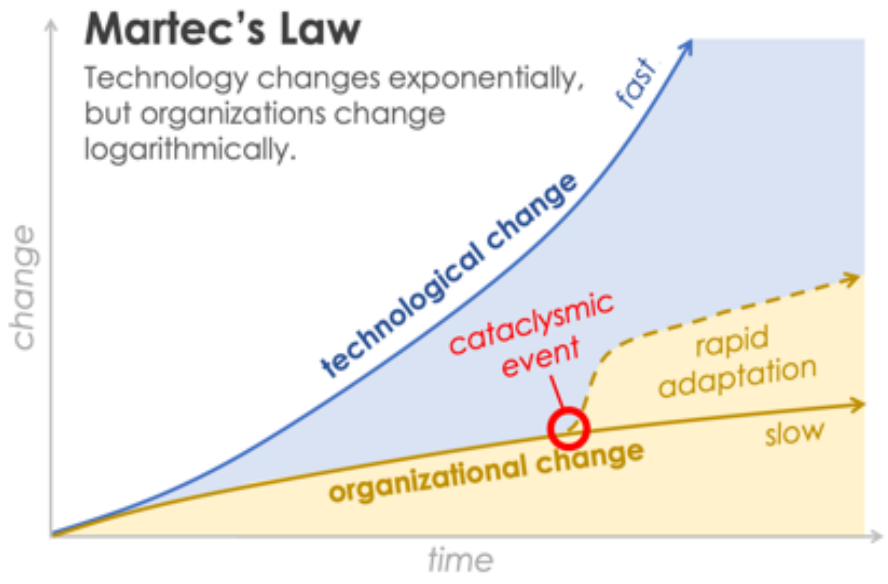
Definitions

- Digital Maturity: “ The capacity of an organization to adopt and take advantage of the digital technologies available”

- Digital Transformation: “the application and use of modern technologies in the organization’s business processes to achieve its goals and increase efficiency“

Company nature





Traditional, M&A created companies have more difficulties to change than technology based / Startups

These companies are subject to Martec´s law – a ever widening gap that requires eventually to reset

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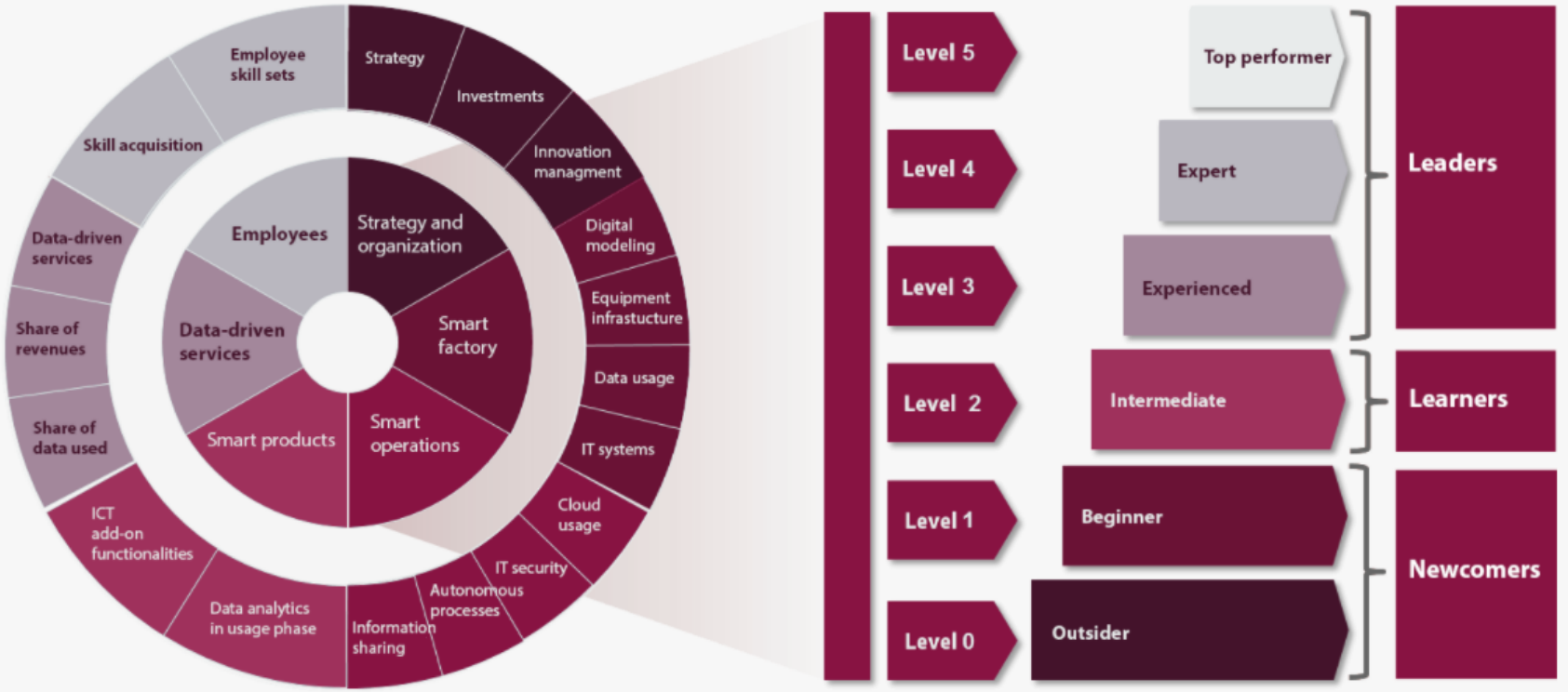
Cloud adoption

Industry 4.0 Readiness
Online Self-Check for Businesses

Where does your business stand? Check your readiness for Industry 4.0!

This self-check lets you calculate your very own Industry 4.0 scorecard. Find out where you are already well prepared for Industry 4.0 and where you still have room for improvement.



The ‘Industry 4.0 Readiness’ study was commissioned by the IMPULS Foundation of the German Engineering Federation (VDMA) and conducted by IW Consult (a subsidiary of the Cologne Institute for Economic Research) and the Institute for Industrial Management (FIR) at RWTH Aachen University.

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Cloud models available

- Cloud is installed on internal company systems, centralized on one or few sites.

In-house / Enterprise cloud

- An in-house cloud complemented with a private or Public cloud

Hybrid Cloud

- HPC resources are located on a certain datacenter, with exclusive use of the enterprise during the contract period

Private Cloud

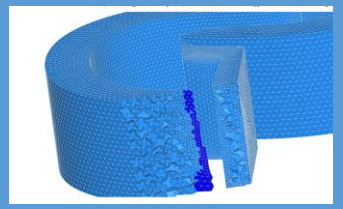
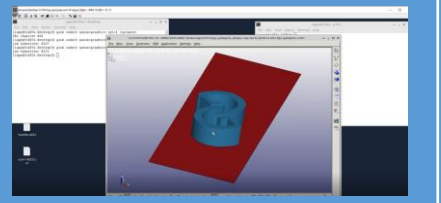
- General access cloud resources, mounted on multi-location providers.

Public Cloud

Cloud models: Decision Drivers

Data Location	Budgetary structure	Management of internal resources	Fluctuating needs:	Electricity and hosting infrastructure:
• Company policies or end customer restriction might force enterprises to run in-house	- Specially on large enterprises with subsidiaries managed by OPEX and CAPEX, owning hardware or part of it could be a requirement. A private cloud option sometimes fits, as all costs can be pre-defined.	• When an IT team is not available, external resources (private or public cloud) are a more viable option	• For those enterprises working per-project with a variable workload, there is a clear adaptation to pure cloud models.	• When the use of simulation grows, more space and power is needed. Allocating a space for this is not an option on certain locations, forcing companies to go for a private or Public cloud.

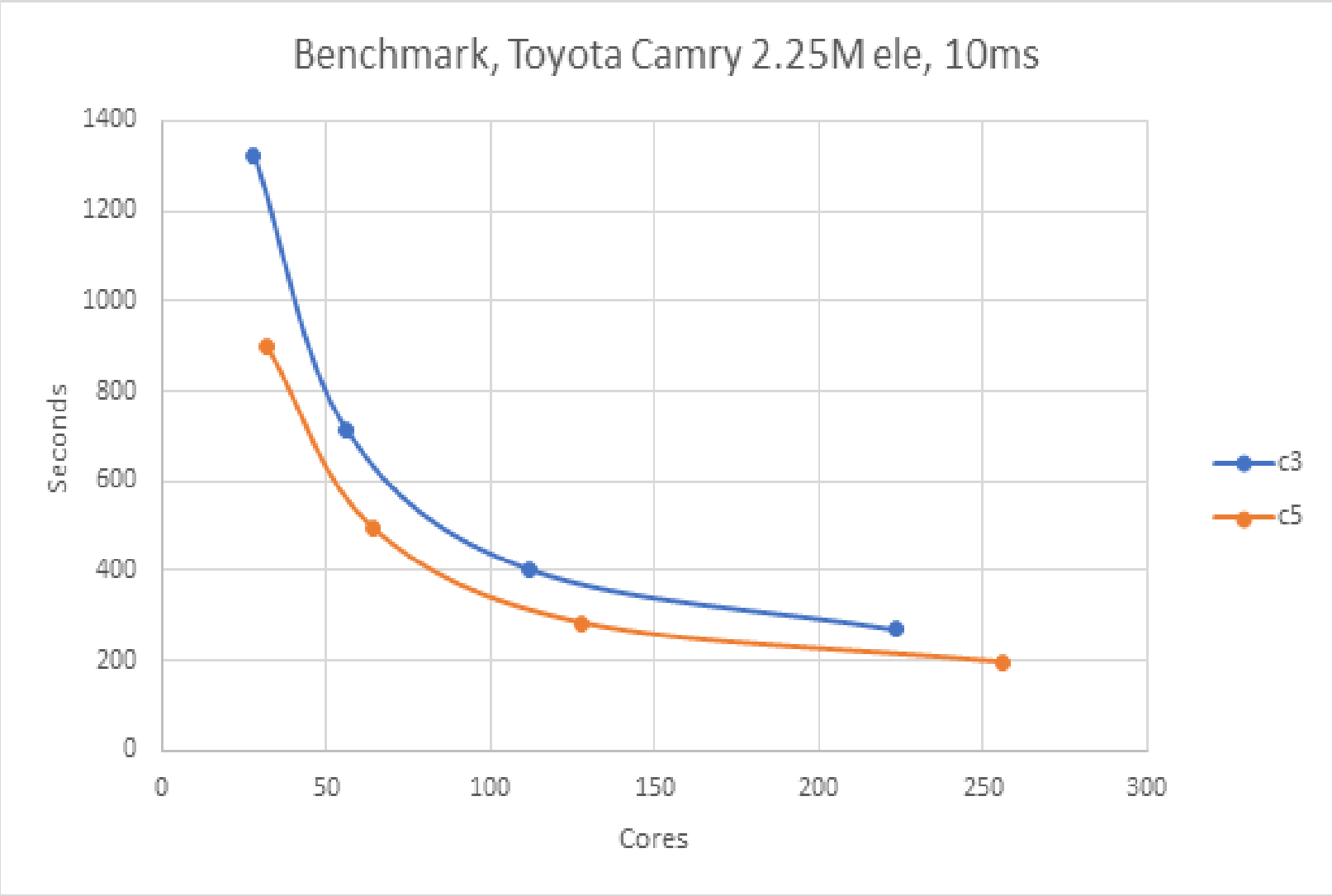
Moving LS-DYNA Workloads to the cloud: Decision Drivers

Workflow	Pre-processing	Solving	Post-processing	Details
				
Pure Cloud	Cloud	Cloud	Cloud	Support for multiple pre-post processors required.
Hybrid	Local	Cloud	local	More data transfer required

Evaluation Criteria for the solver

- Generation of the architecture: Vendors have different architectures available, that must be evaluated. A discounted price on a previous generation can offer the users to get more cores within a certain budget, sometimes sacrificing a small percentage in performance per core
- Number of cores per node: The scalability and model sizes need to be evaluated in different architectures, always checking the license restrictions
- Virtualization or bare-metal nodes: Virtualization might affect final simulation performance, so a bare-metal configuration is always preferred
- Interconnect: When running multi-node, a fast interconnect is required in order to keep the scalability
- Tuning: The installation and configuration needs to be tested and adjusted for a certain hardware type in order to get maximum performance

Performance Evaluation



Benchmark representation on C3 nodes (Intel E5-2680v4) and C5 nodes (Intel Gold 6242)

Connectivity Options

Direct	IP-Restricted	VPN	Private Line
• Access is available over the internet.	• Only certain IPs can access the service. For users on home-office a static IP is required.	• Customer enterprise is connected to the resources on a VPN. Users working from home need a VPN to their company to access the service.	• Customer is accessing the service directly. Is the best-performing solution, price depends on distance to the data center

LS-DYNA Licensing

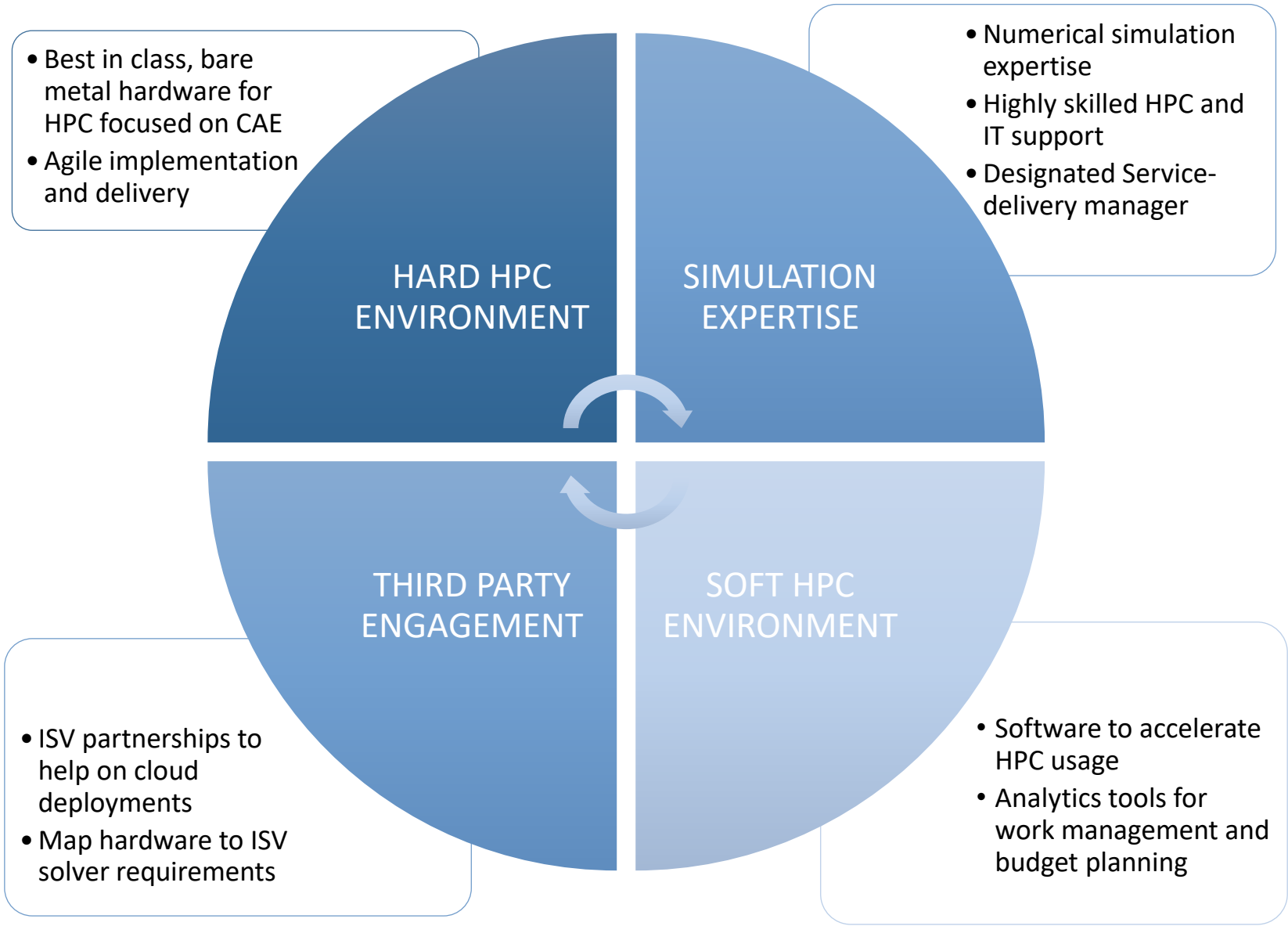
In-house license server(s) per site

Cloud based license server(s)

Global (internal) license server

AEU / On-demand

Summary: Four pillars



Literature

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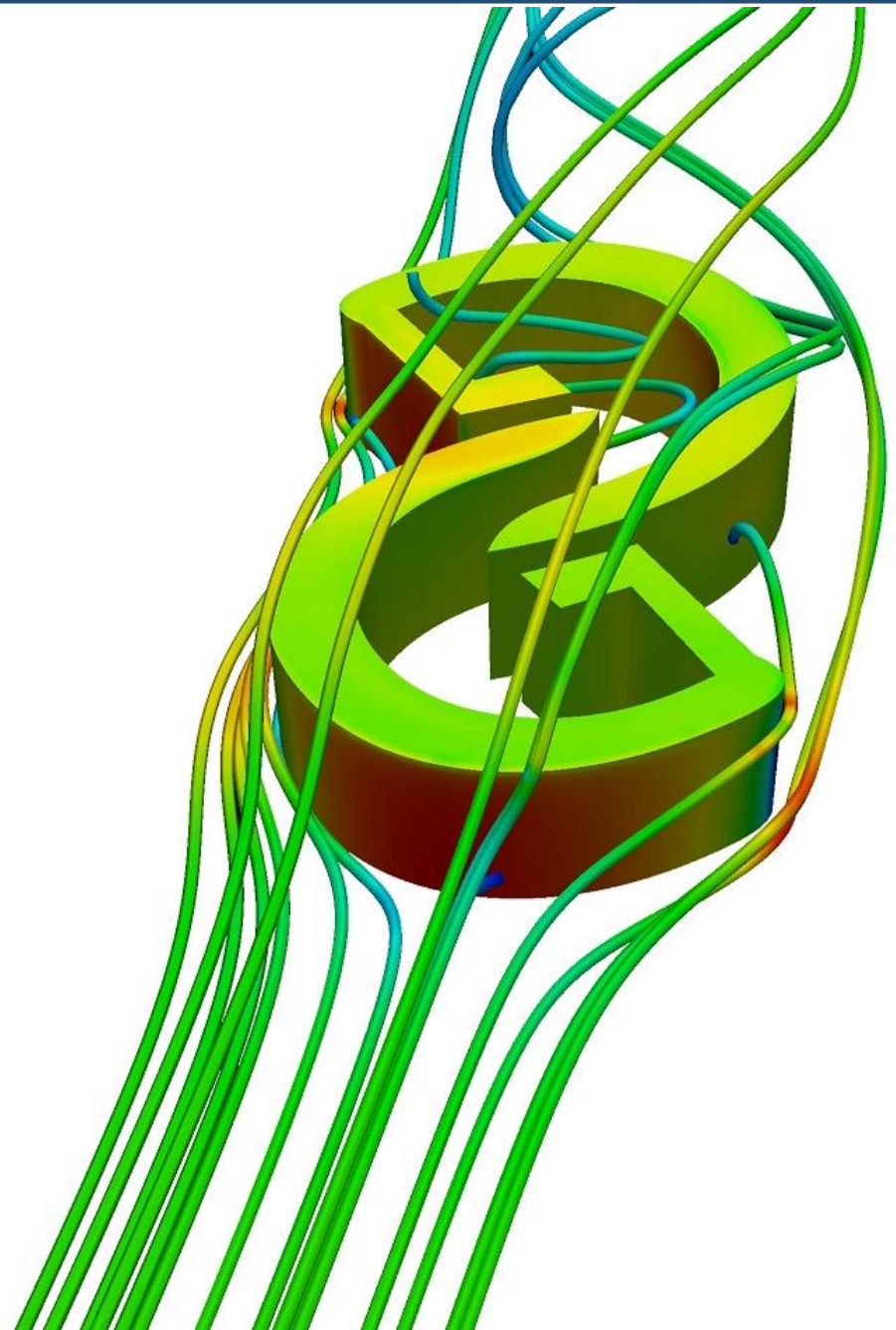
[2] Brinker, S. “Martec’s Law: Technology Changes Exponentially, Organizations Change Logarithmically.” Chief Marketing Technologist (blog), June 13, 2013. https://chiefmartec.com/2013/06/martecs-law-technology-changes-exponentially-organizations-change-logarithmically/

[3] Kupilas, K., Montequín, V. & Álvarez-Pérez, C. & Balsera, J (2021). Industry 4.0 and Digital Maturity, Chapter 2.



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