



Ontology-based Semantic and Meta Data Management

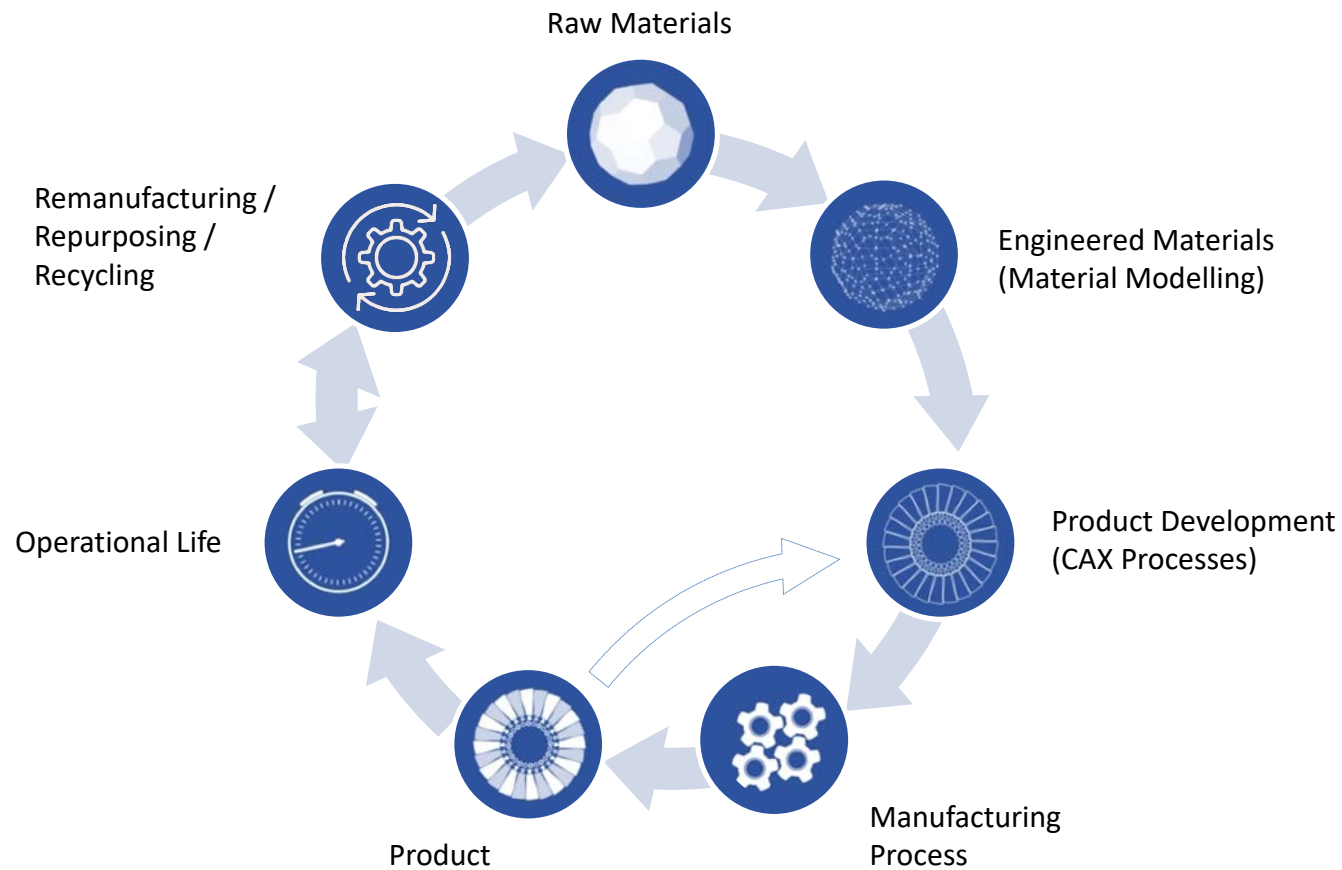
VMAP User Forum
18-19 February 2025



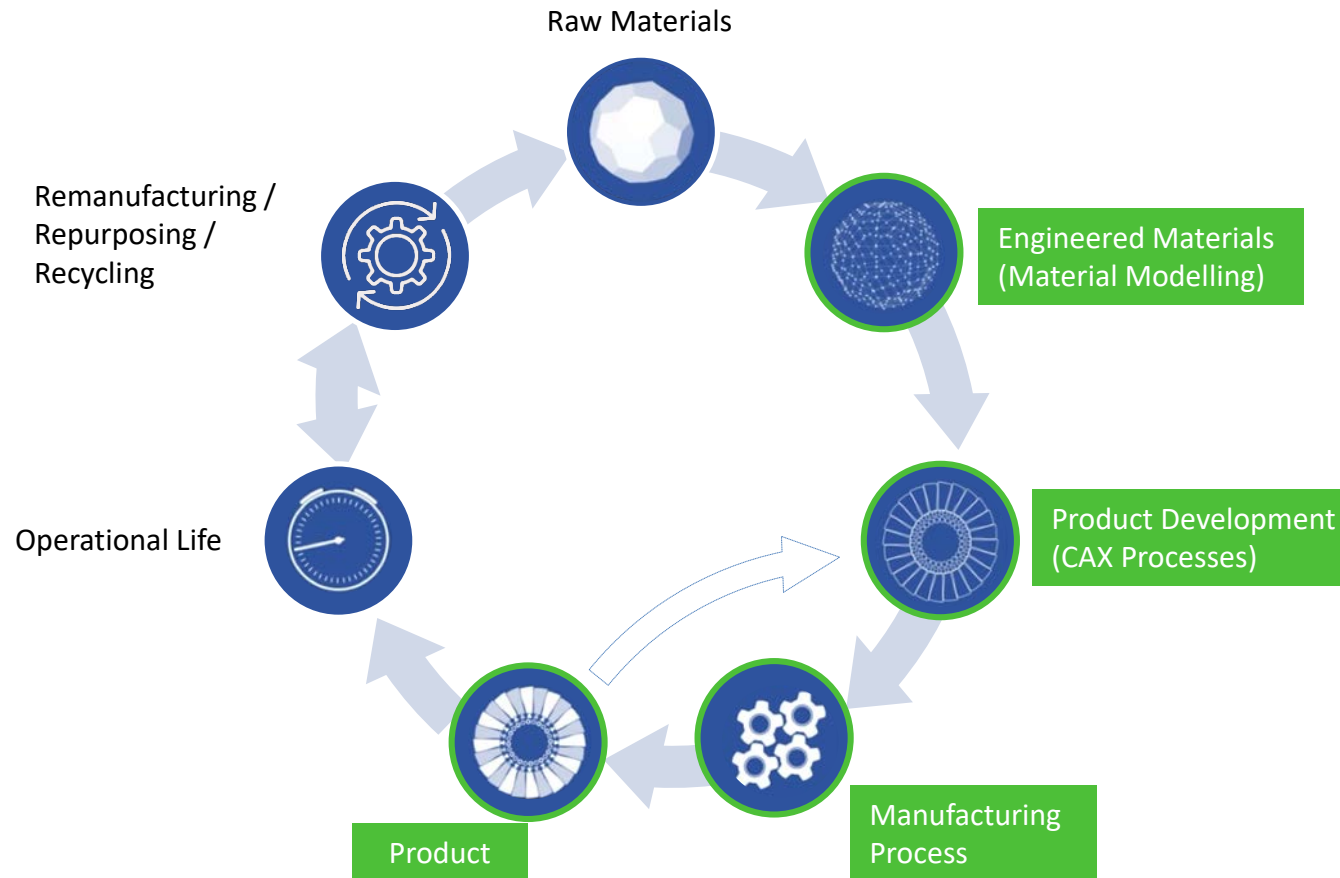
www.vmap-standard.org

Xuebilian Gong and Arpitha Nagaraja

Product Lifecycle

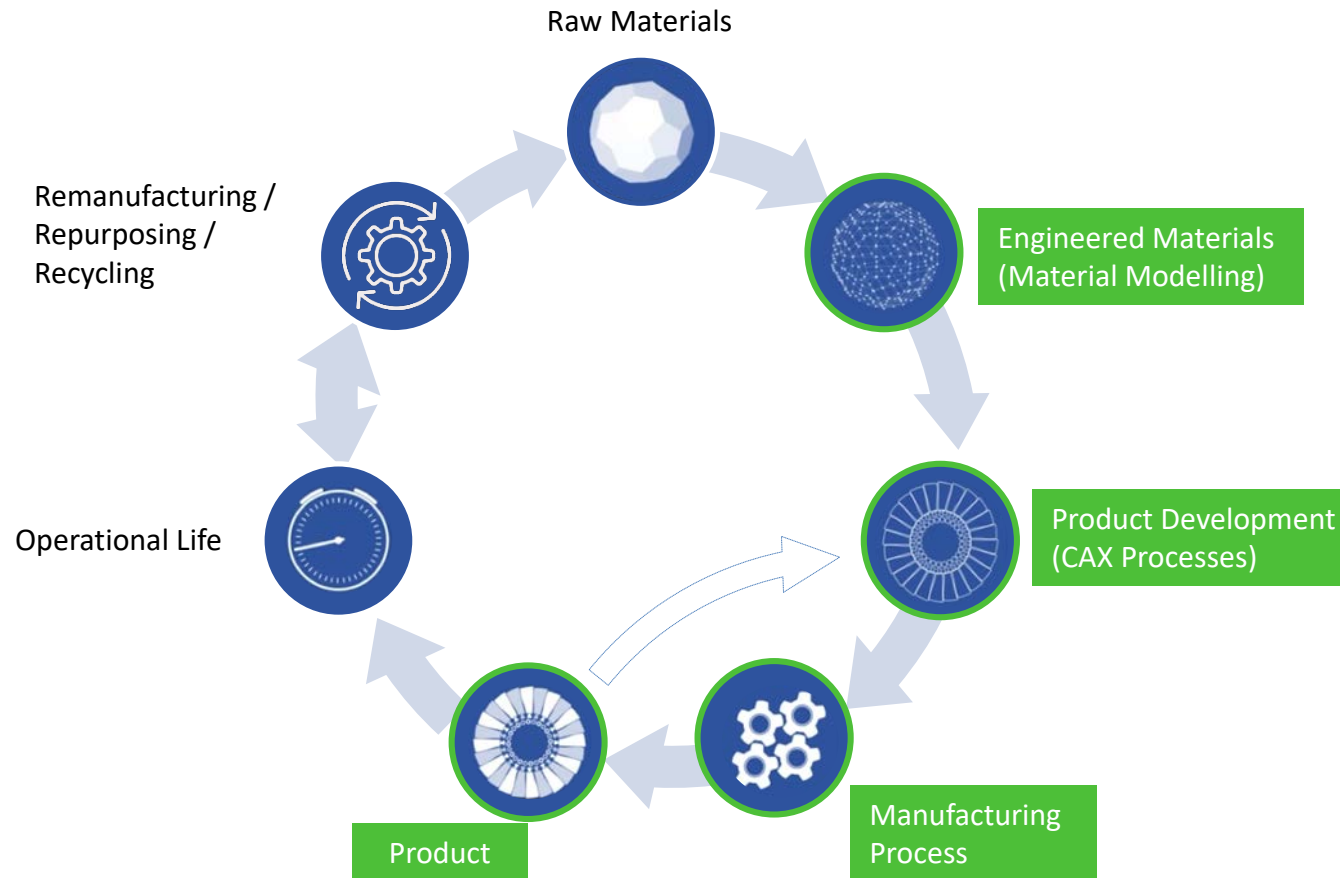


Projects



- Develop an open innovation platform to optimize production systems by integrating product development, virtual engineering, and production data.
- Focus is on two different manufacturing techniques: Sheet Molding Compound & Wire-Arc Additive Manufacturing.

Projects

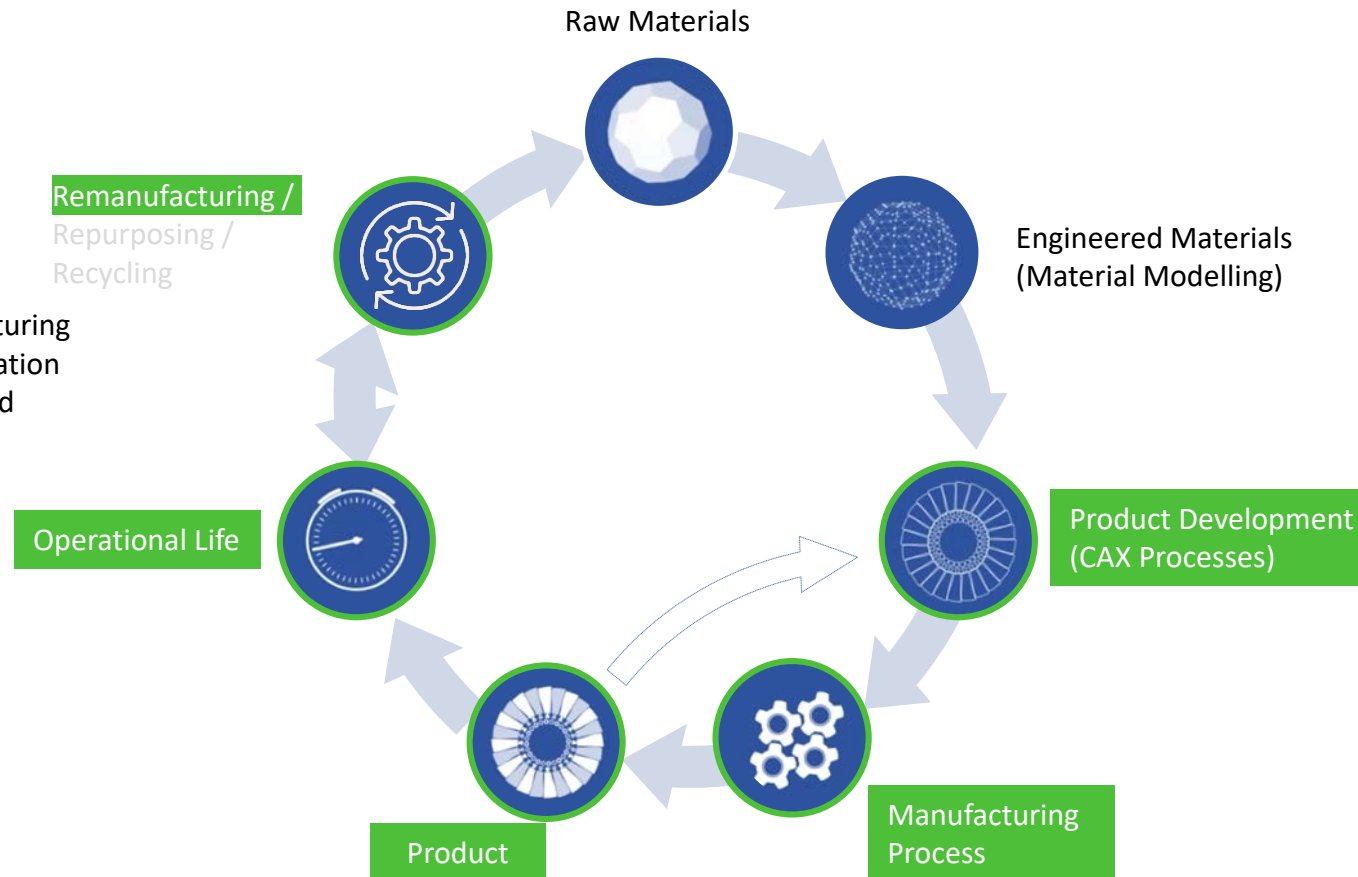


- Develop and enhance adaptive laser technologies for AM by optimizing beam shaping to enhance material properties and reduce defects.
- Focus is on aerospace, maritime, and automotive applications.

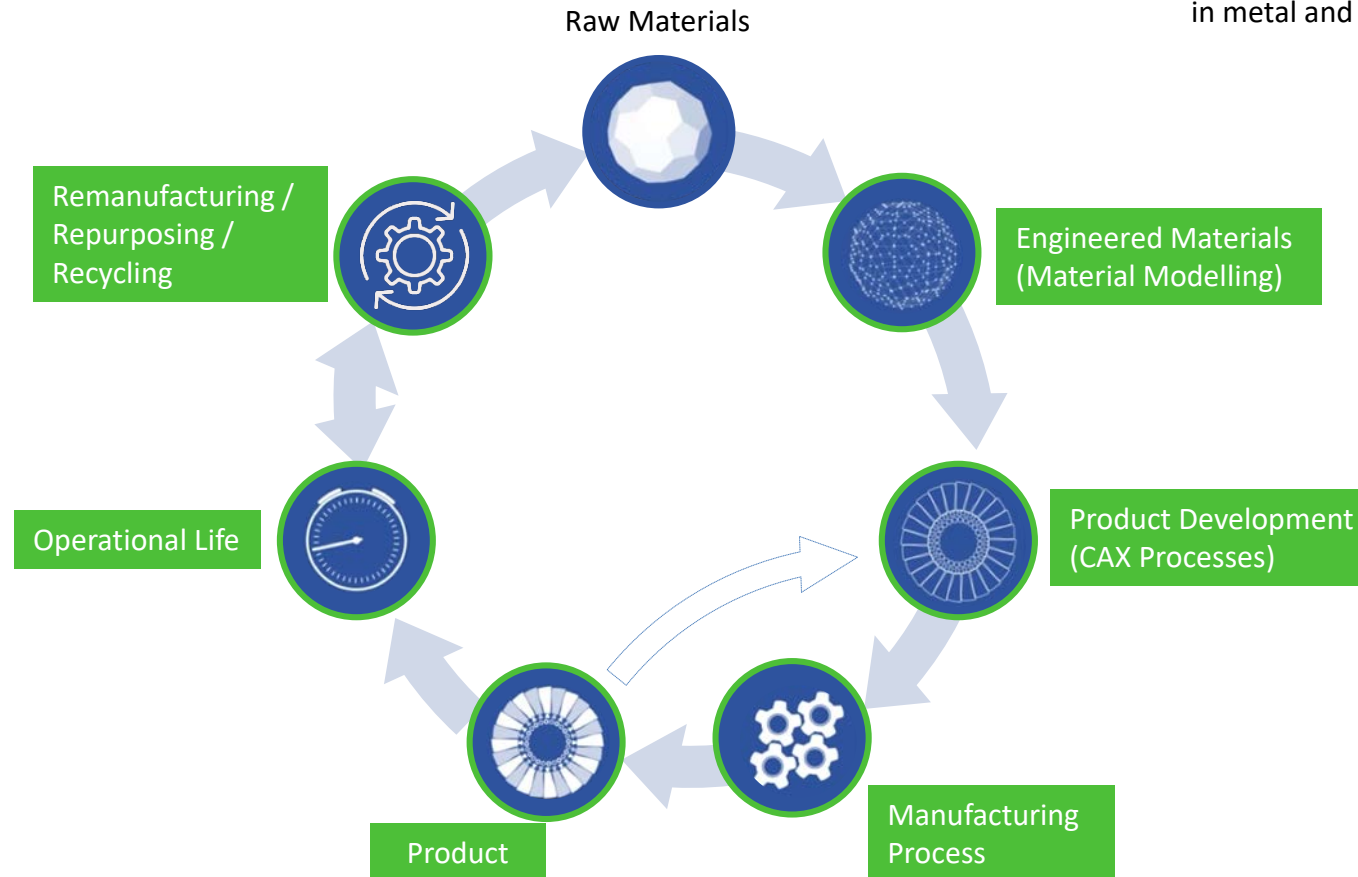
Projects



- Develop sustainable remanufacturing solutions with increased automation and recycled content in laser and plasma-based processes.



Projects



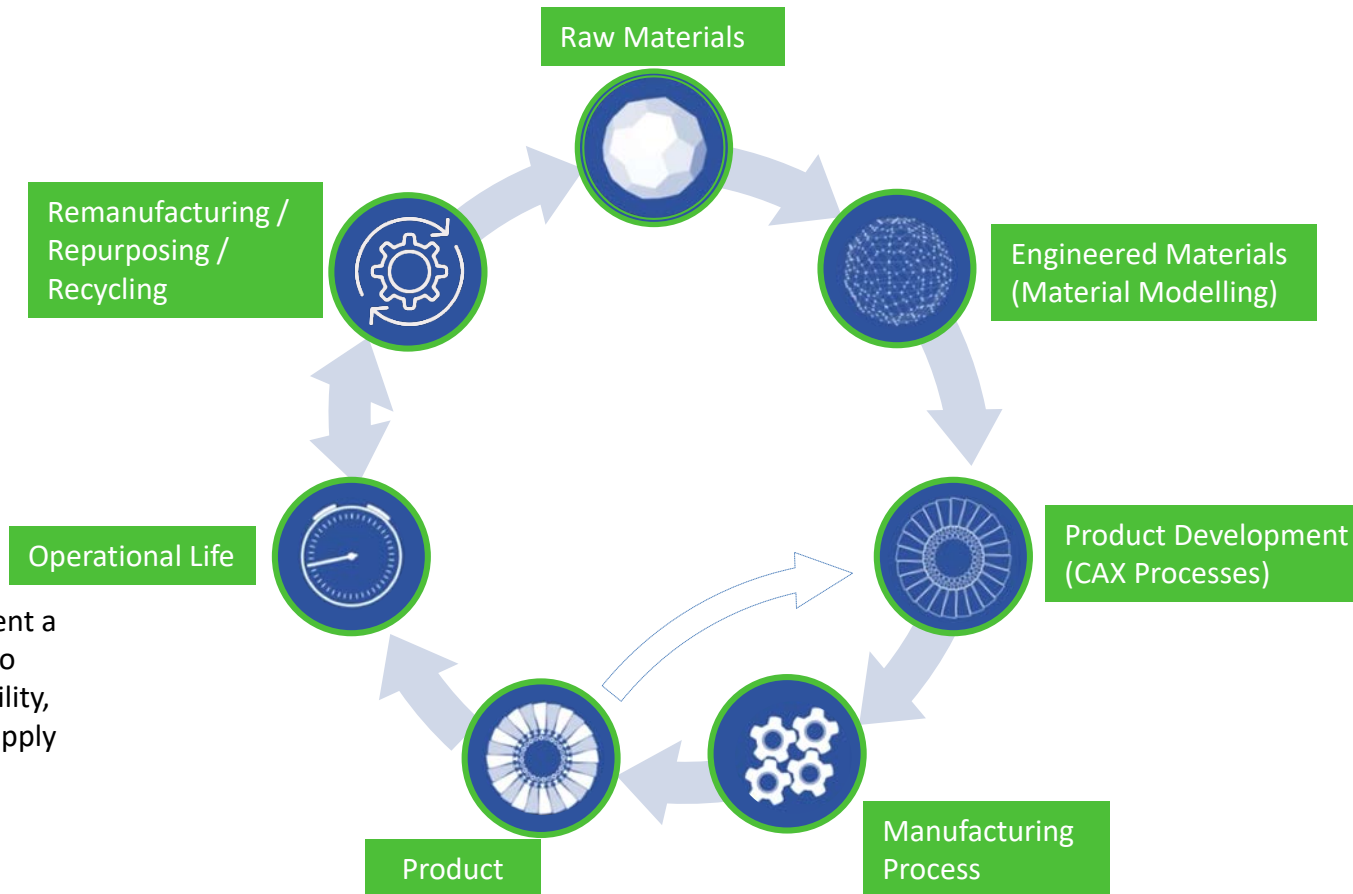
- Develop digital tools (simulation-based / AI-driven approaches) to facilitate the use of recycled materials in metal and plastics processing.



Projects



- Develop, validate, and implement a Digital Battery Passport (DBP) to enhance traceability, sustainability, and circularity in the battery supply chain.



Projects



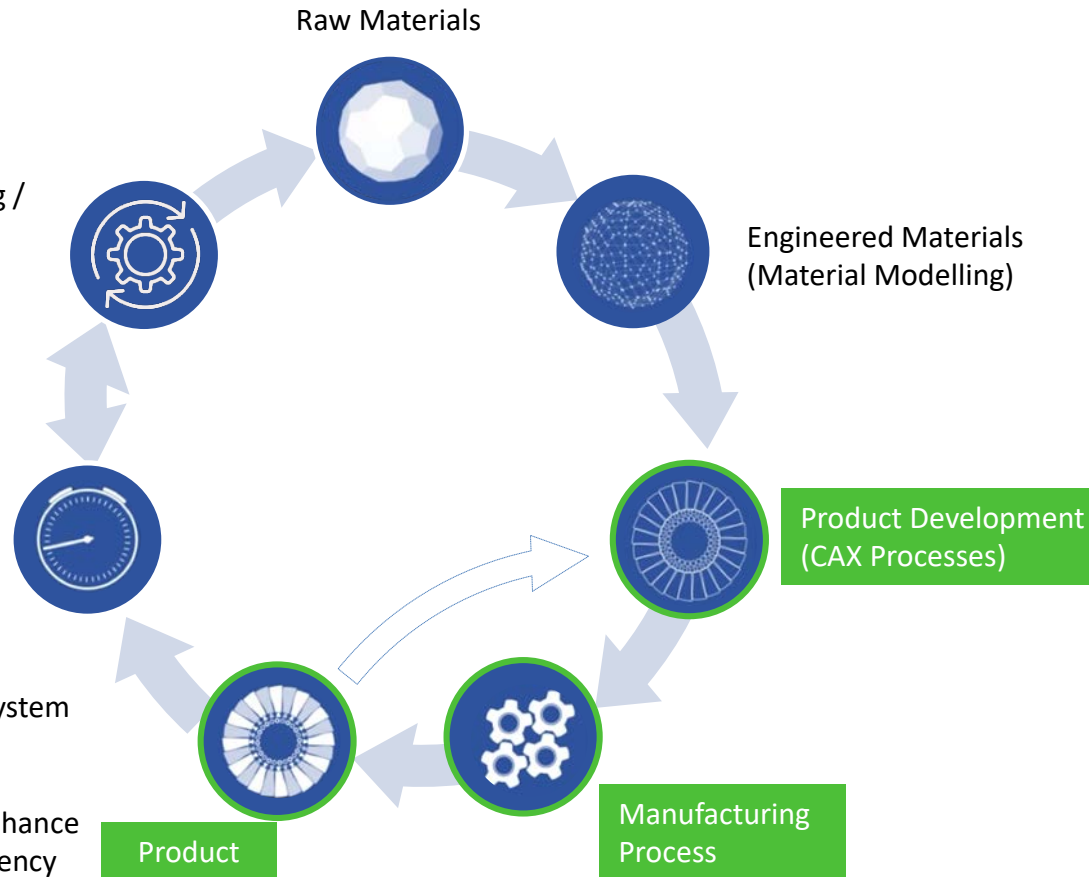
Remanufacturing /
Repurposing /
Recycling



Operational Life



- Develop a standardized system for creating, sharing, and reusing computational engineering models to enhance interoperability and efficiency in engineering design.

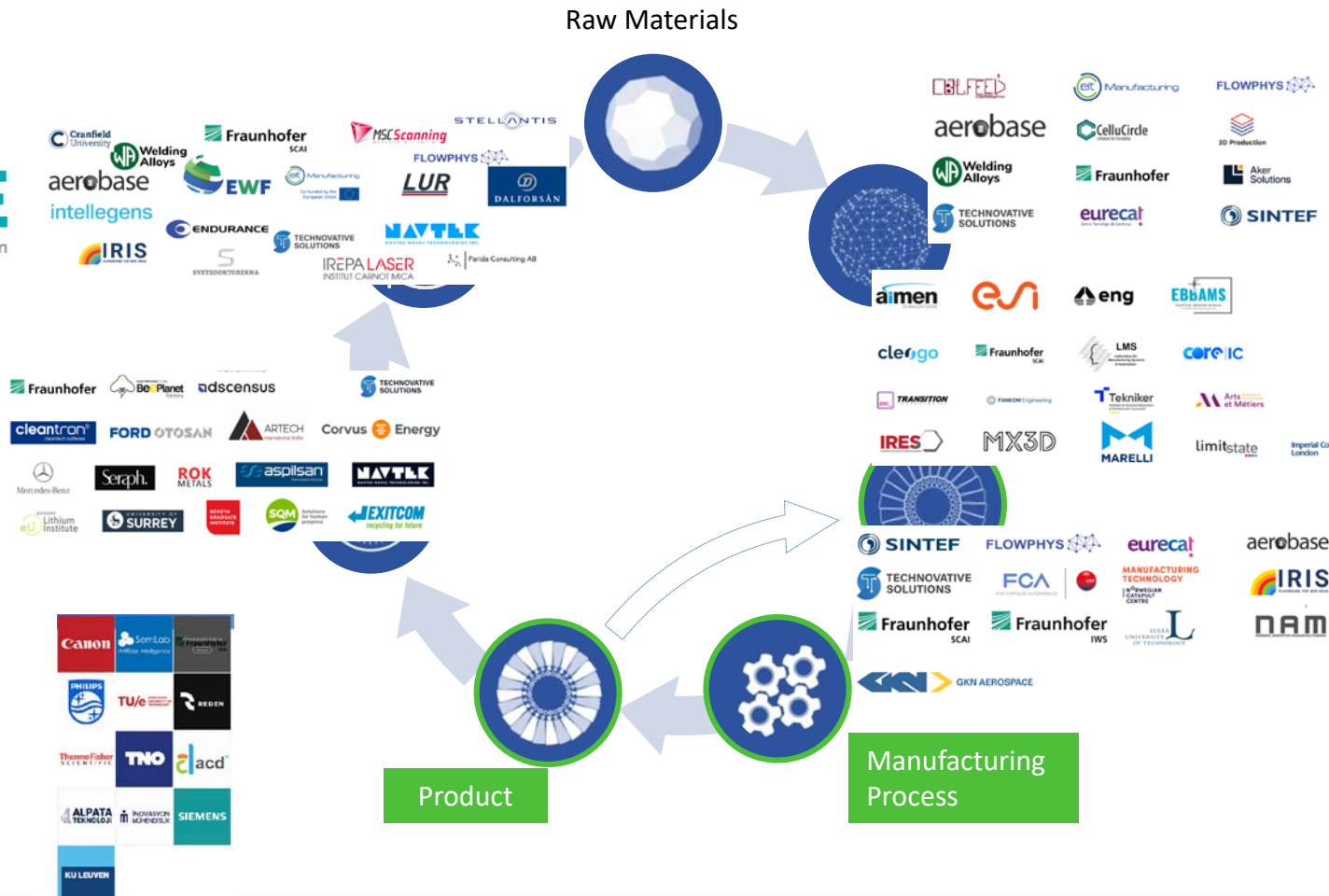


Projects

RESTORE
Sustainable remanufacturing solution

BAE
Battery Passport for Transparency and Circularity

smart

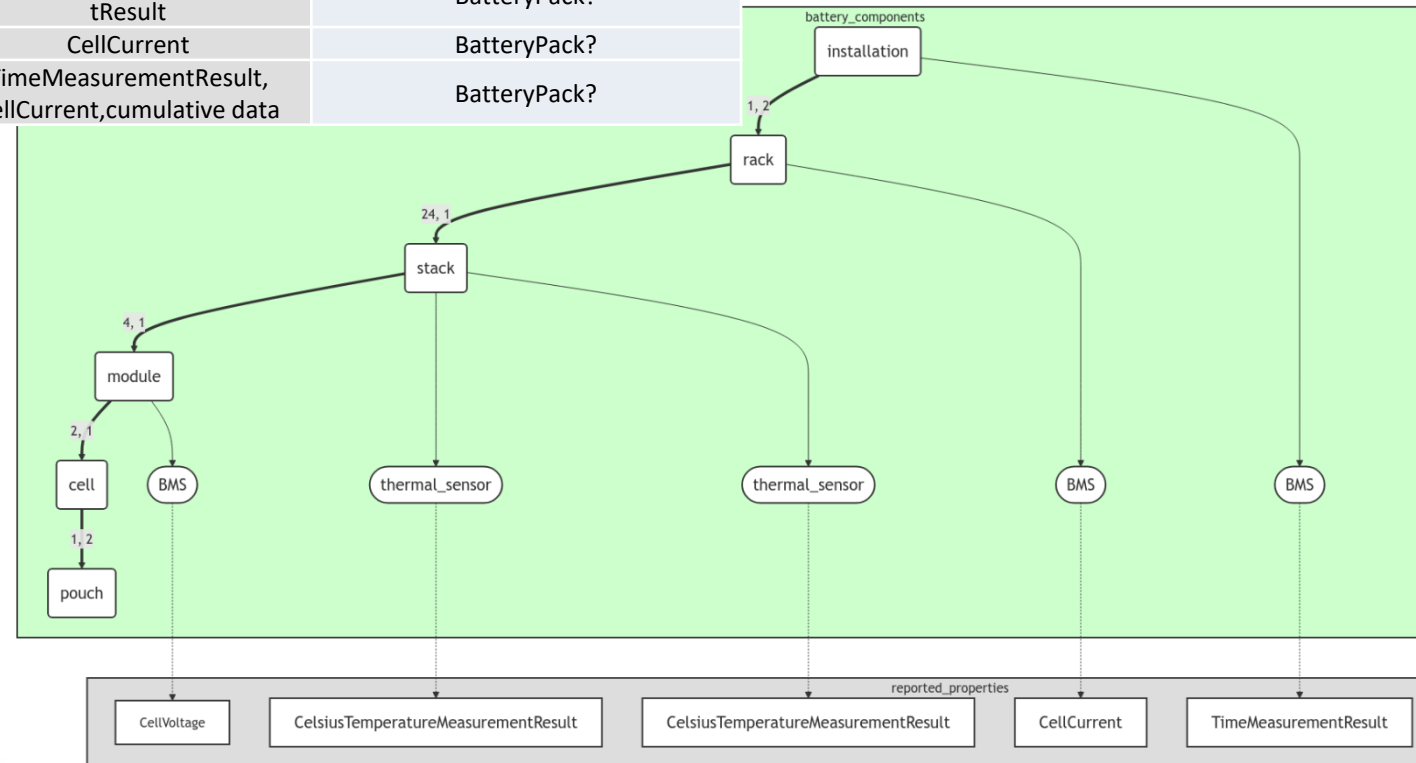


Pioneer

ALABAMA

BASE Semantic data modelling - packaging

name of building block	name of electrical component	configuration	other component(s)	number of other component(s)	reported data	BB prefLabel
pouch		1s1p		0		PouchCell,LithiumManganeseDioxideBattery
cell	pouch	1s2p		0		BatteryModule?
module	cell	2s1p	BMS	1	CellVoltage, balancing	BatteryModule?
stack	module	4s1p	thermal sensor	3	CelsiusTemperatureMeasurementResult	BatteryPack?
rack	stack	24s1p	BMS	1	CellCurrent	BatteryPack?
installation	rack	1s2p	BMS	1	TimeMeasurementResult, CellCurrent,cumulative data	BatteryPack?



Battery Description File

- Building hierarchy
- Level names differ between providers/users

BASE Semantic data modelling –life time estimation

(pattern of) original column names	PrefLabel of property	unit	comment	scope
time	TimeMeasurementResult	YYYY-MM-DDTHH:MM:SSZ	ISO 8601	installation wide
mean_system_current	CellCurrent	Ampere		installation wide
mean_current{rack_index}	CellCurrent	Ampere	rack_index: single digit	rack wide
voltage{rack_index}_c{cell_index:03}	CellVoltage	Volt	cell_index: three digits, leading zeros	cell specific
temperature{rack_index}_t{sensor_index:03}	CelsiusTemperatureMeasurementResult	degCelsius	sensor_index: three digits, leading zeros	sensor specific, stack wide
balancing{rack_index}_c{cell_index:03}		boolean	on(1),off(0)	cell specific
mean_SoC	StateOfCharge, average	%		installation wide
mean_max_cell_temperature_value	CelsiusTemperature, maximum, average	degCelsius	processed property	installation wide
mean_min_cell_temperature_value	CelsiusTemperature, minimum, average	degCelsius	processed property	installation wide
mean_avg_cell_temperature_value	CelsiusTemperature, average, average	degCelsius	processed property	installation wide

Observation Description File

- Original column patterns → Proposal for unified definitions (pref labels)

Heterogeneous Data Sources

Heterogeneous data sources

Structural heterogeneity

Semantic heterogeneity

building block	subunit
pouch	
cell	pouch
module	cell
stack	module
rack	stack
installation	rack

Battery pack producer

building block	subunit
cell	none
cell-block/serial element	cell
cell-module	cell-block
module	cell-module
string/pack	module
array	string

Battery 2nd life repurposer

Semantic Interaction

Battery Designer



- Please show me how cycling stability of batteries with different electrolyte varies under extreme temperature conditions.
- Please show me a comparison of the 'lifespan estimate' between batteries made of different materials but that have been subjected to similar load cycles.

Recycler



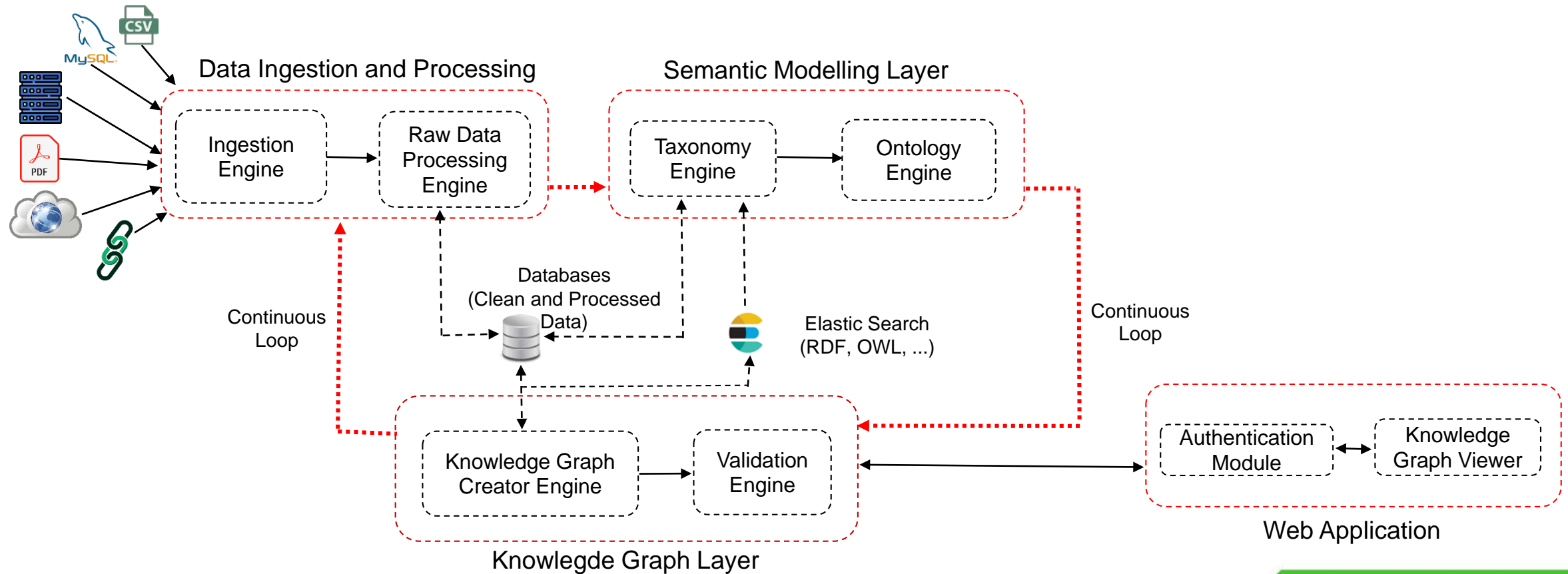
- Please show me the recycling rates for different battery chemistries and their environmental impacts.
- Please show me a comparison of the implementation and compliance requirements of hazardous materials disposal regulations in batteries across different European countries.

Government

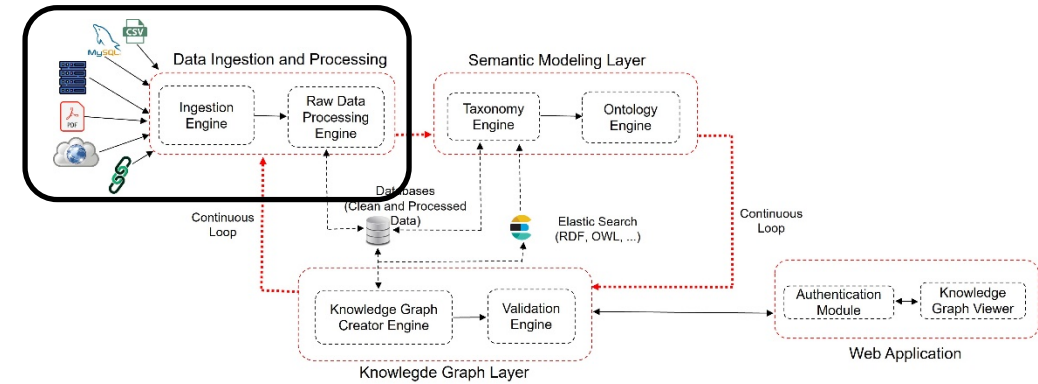
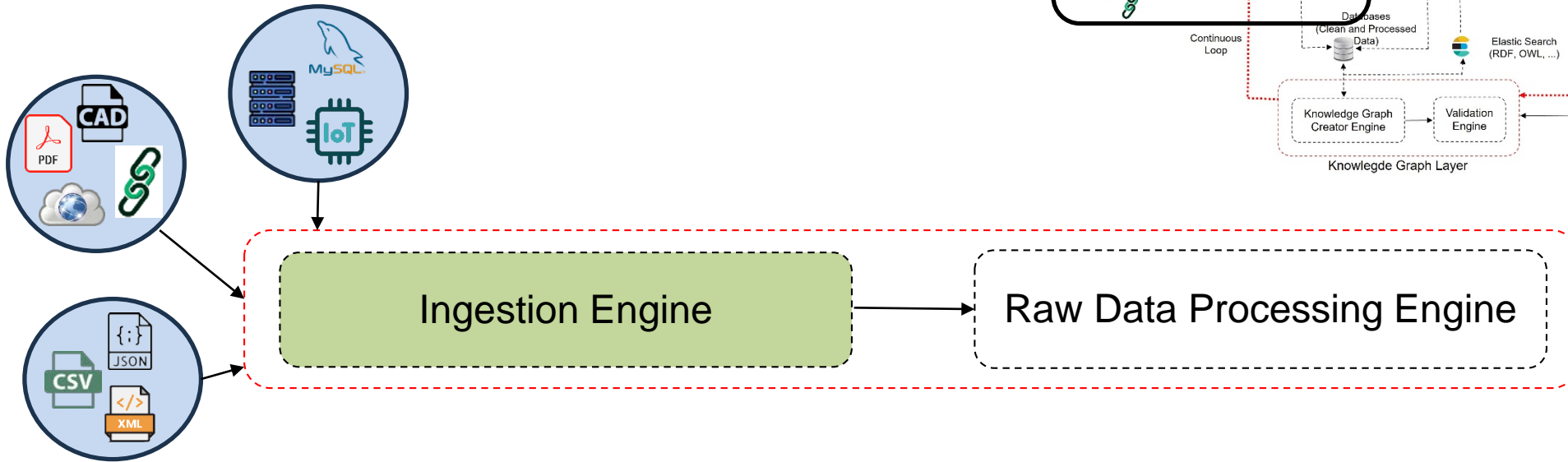


- Please show me the recycling rates of batteries with critical raw material Lithium, grouped by use (automotive, marine, etc.) and packaging (type and size).
- Please show me the lifecycle assessment data for recycled vs. newly produced batteries in terms of carbon footprint and energy consumption.

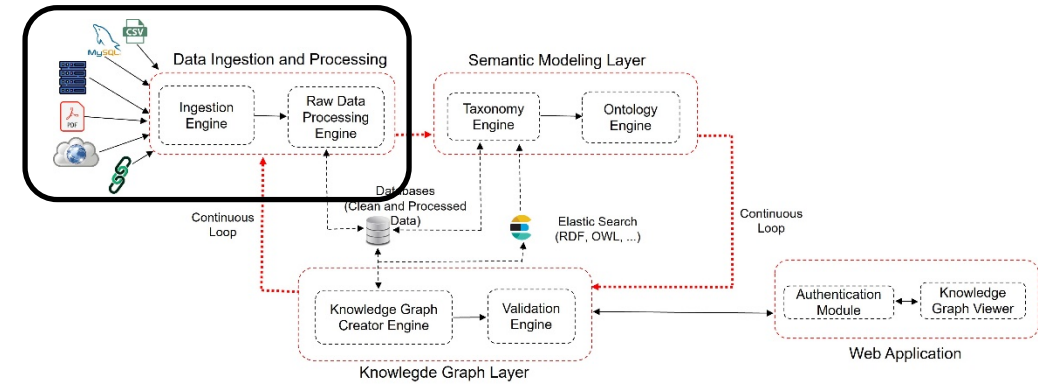
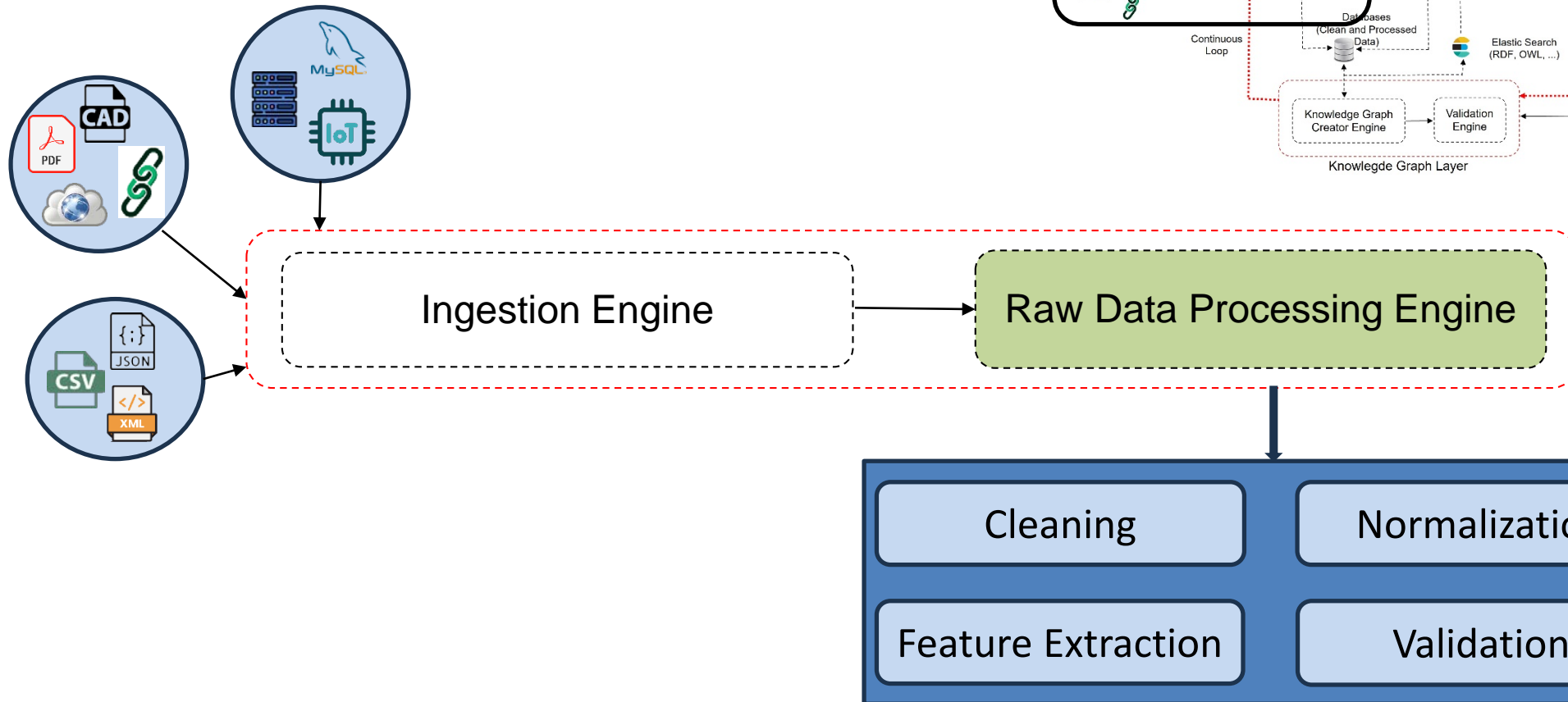
Information Management System



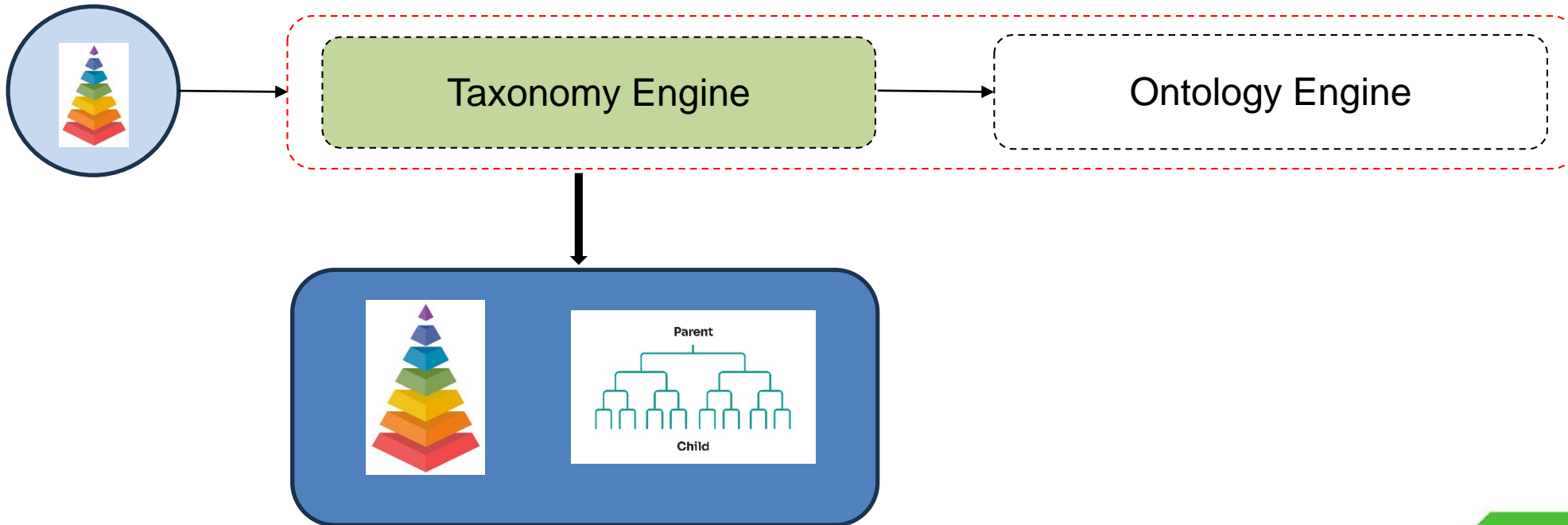
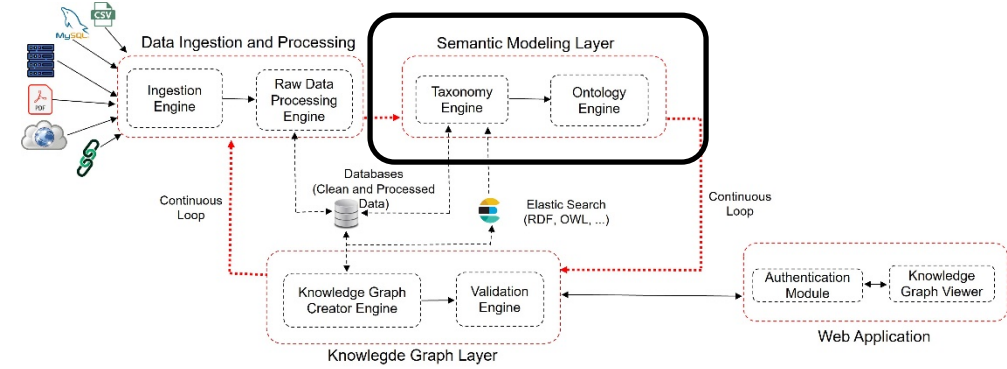
Data Ingestion and Processing



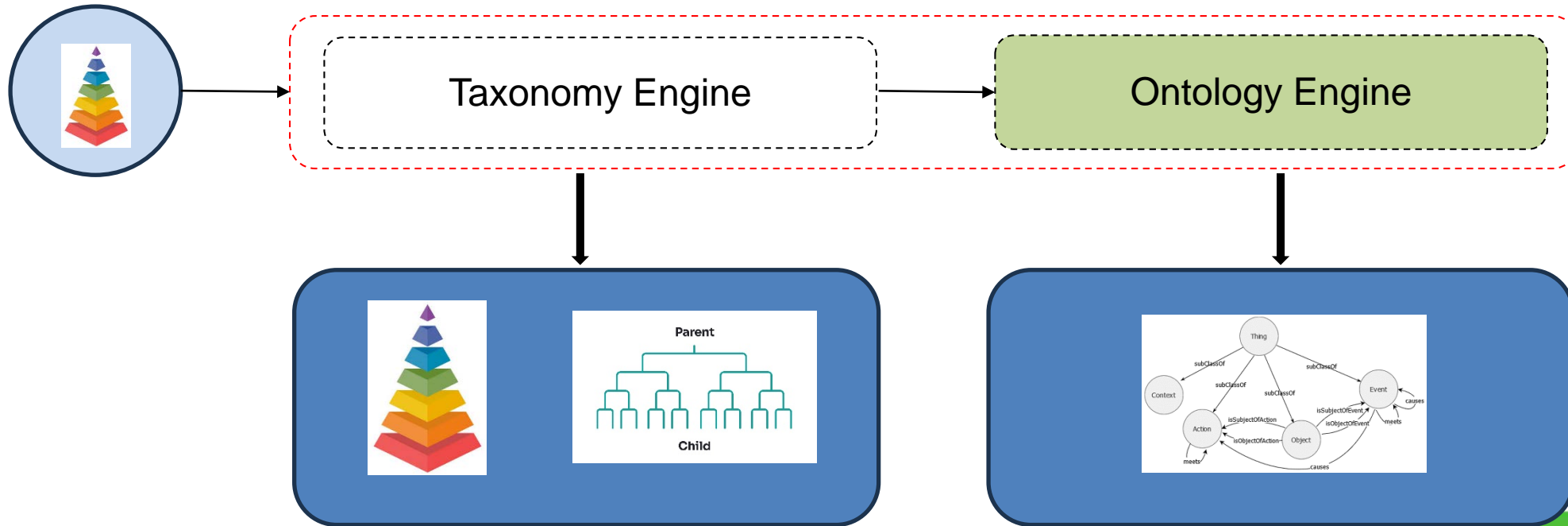
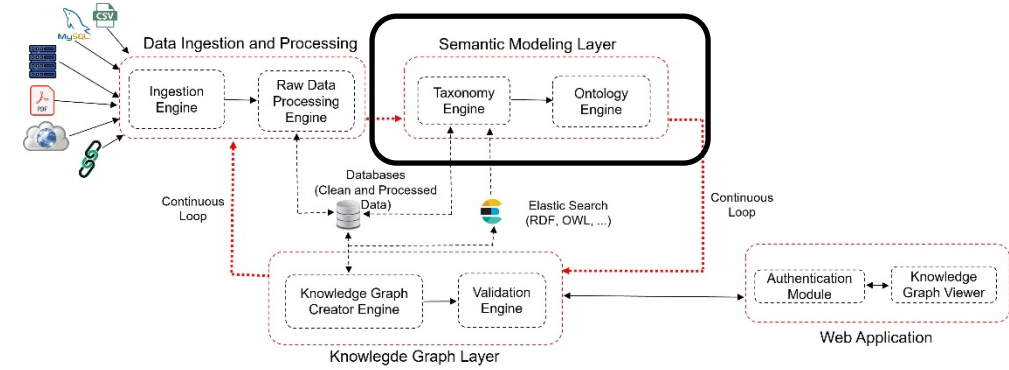
Data Ingestion and Processing



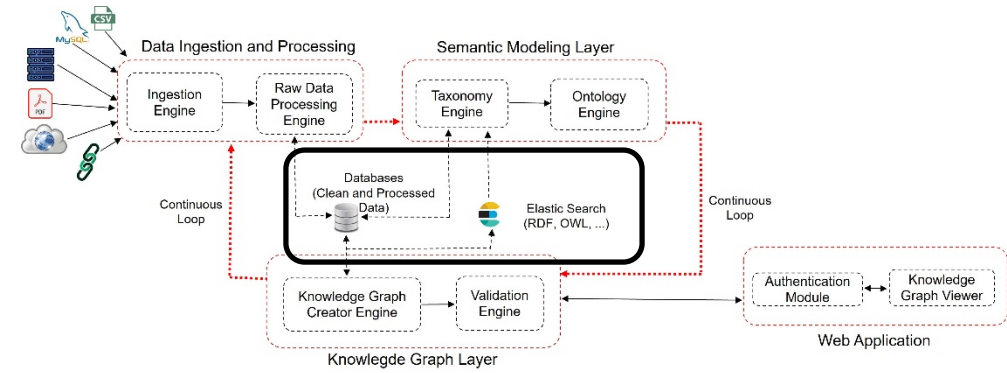
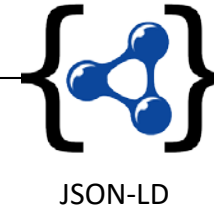
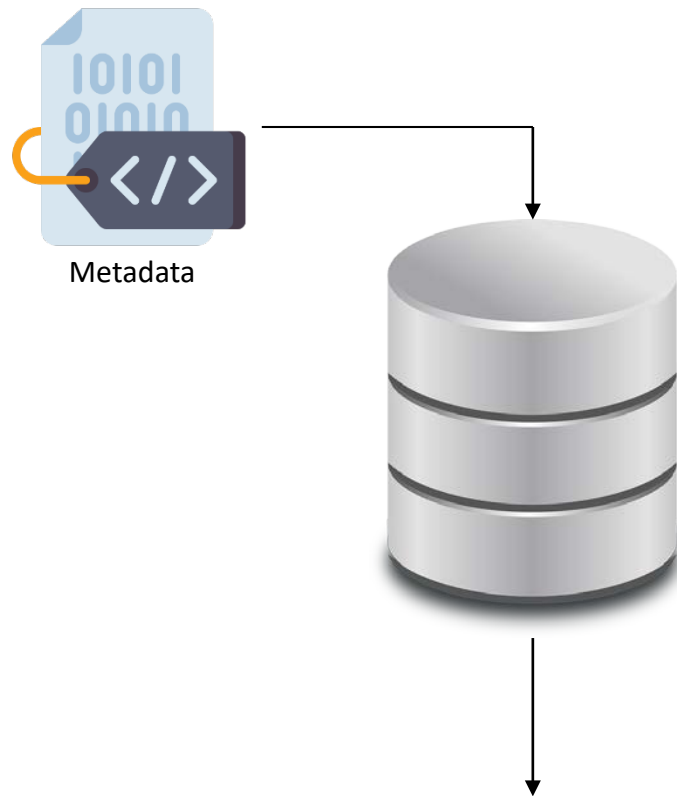
Semantic Modelling Layer



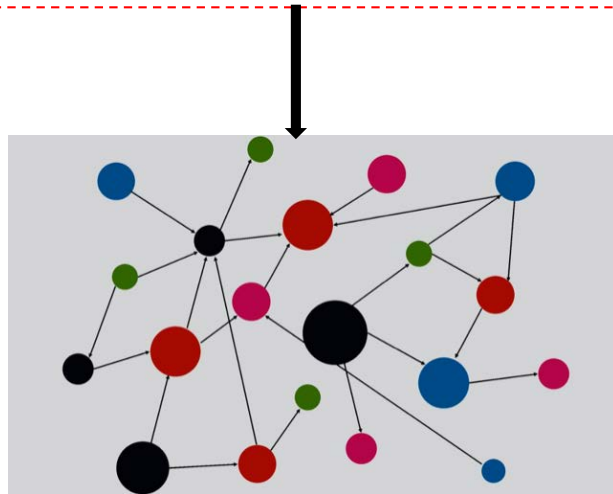
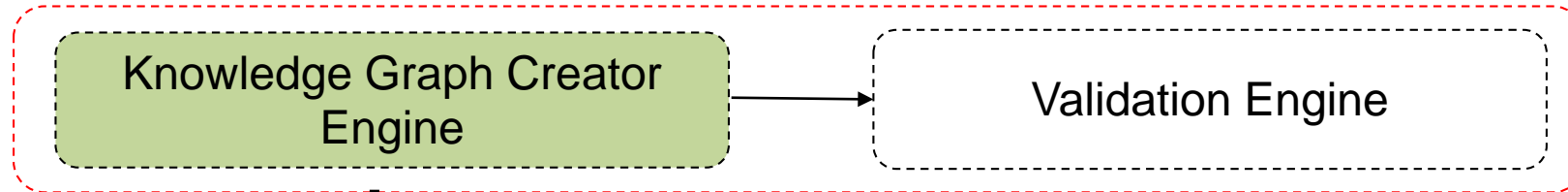
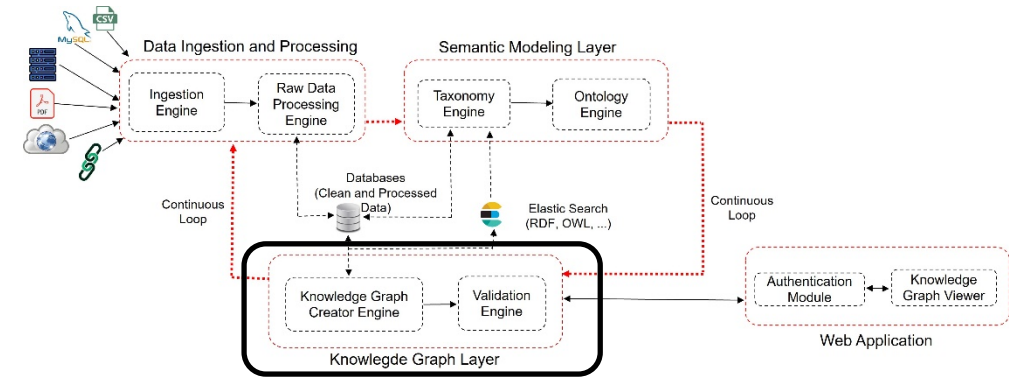
Semantic Modelling Layer



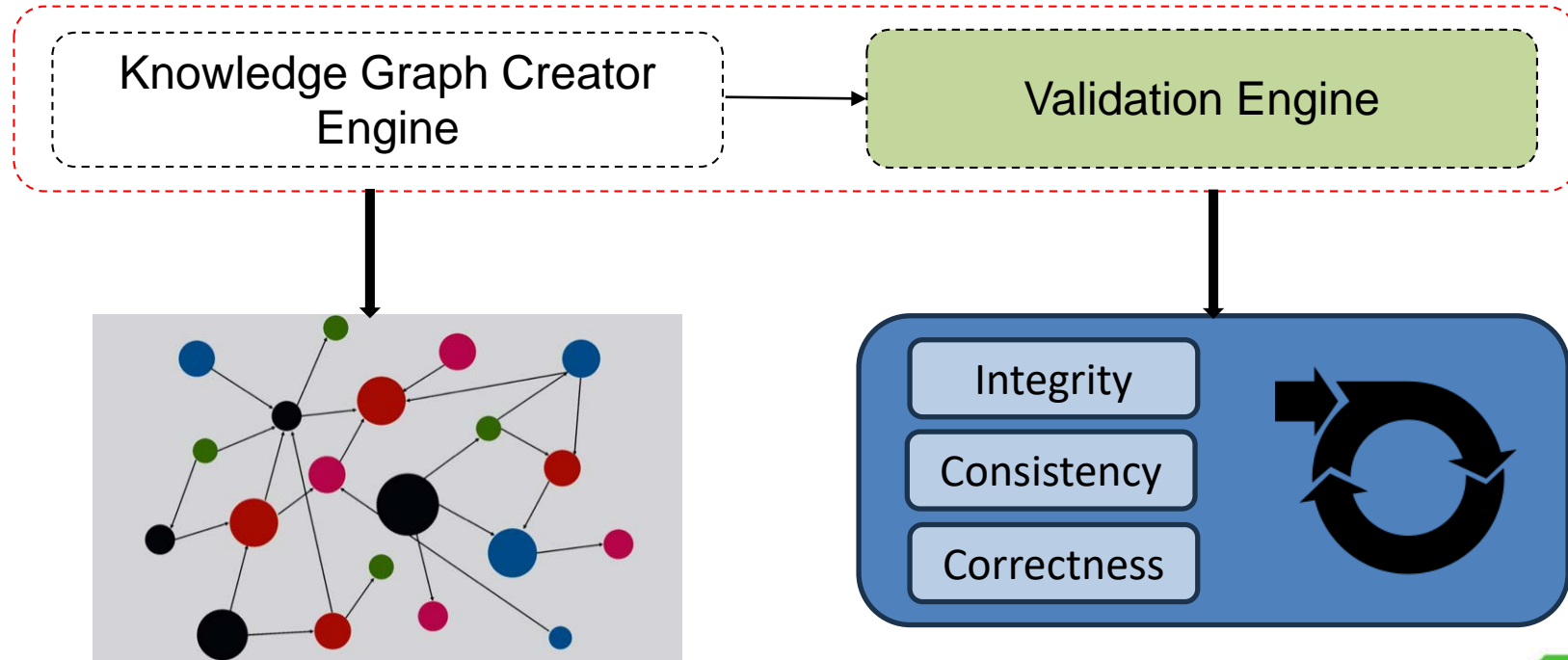
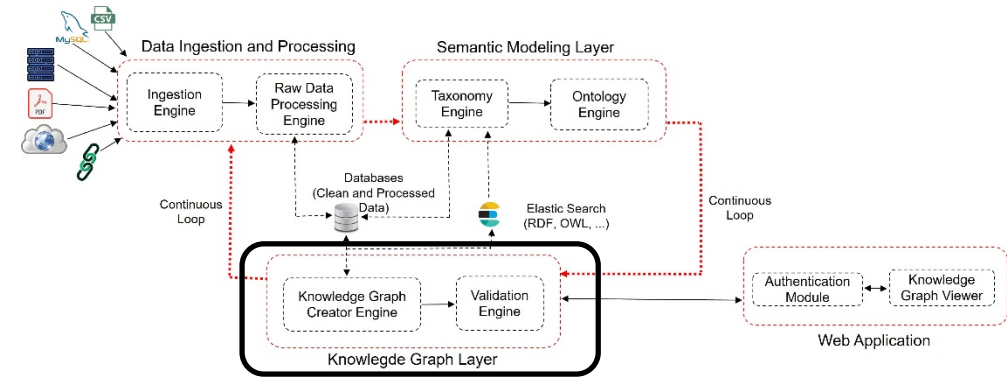
Distributed Storage Layer



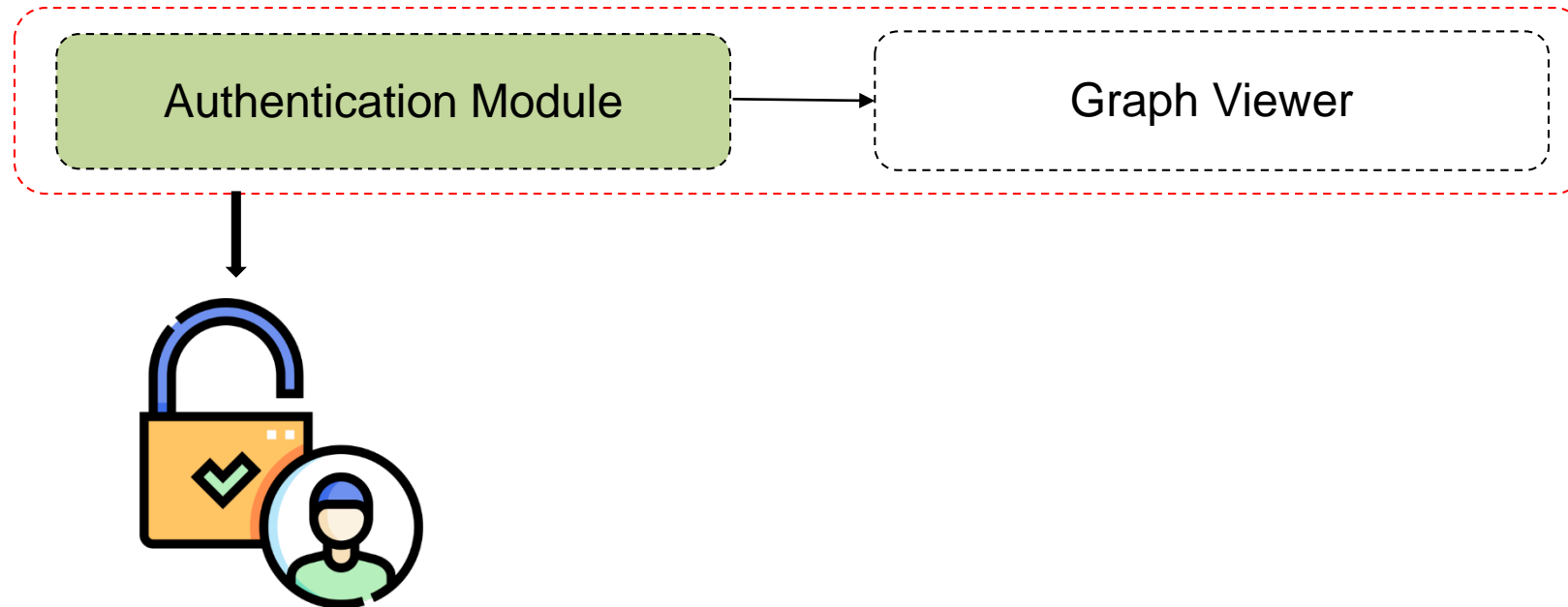
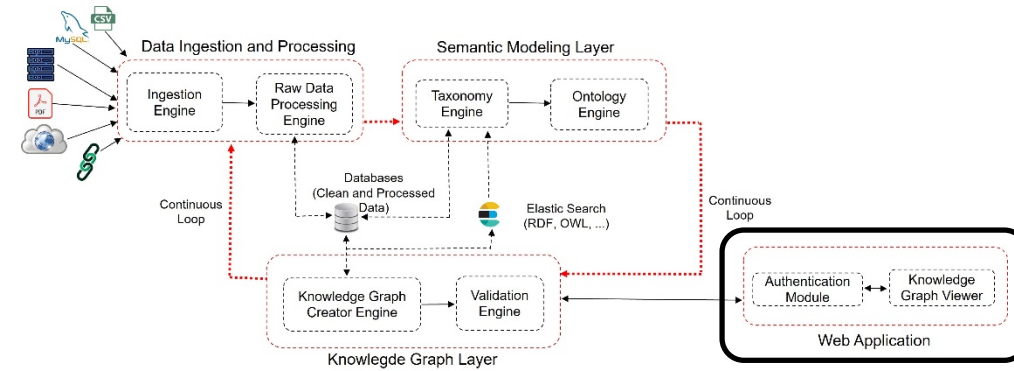
Knowledge Graph Layer



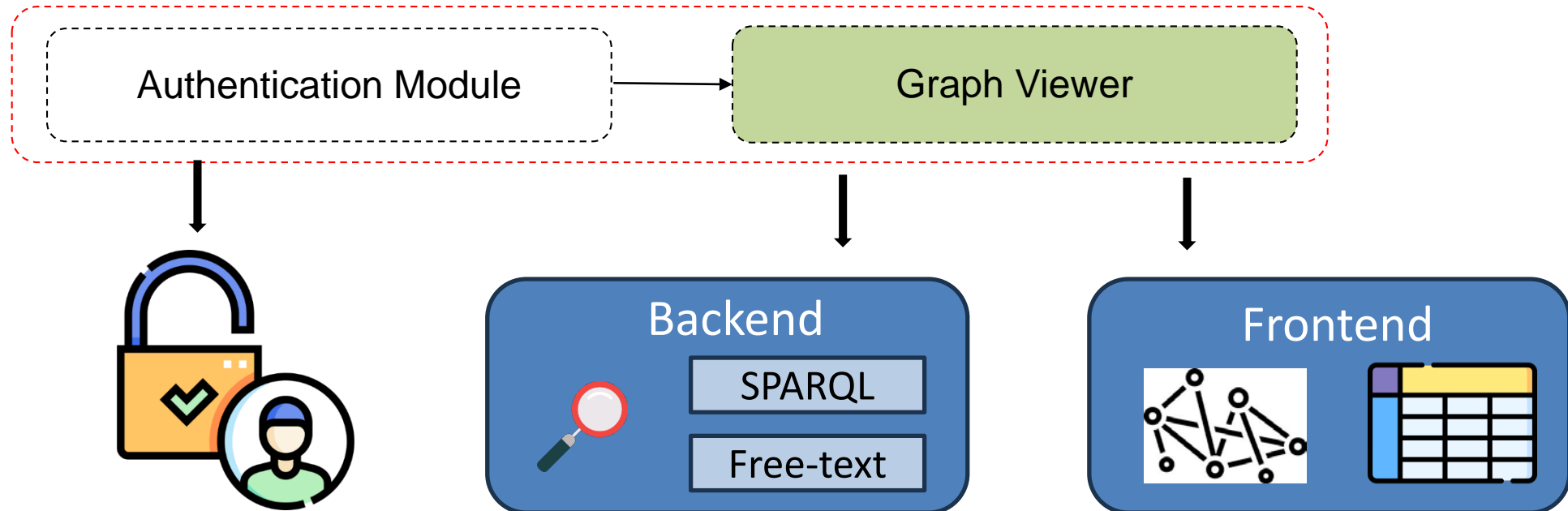
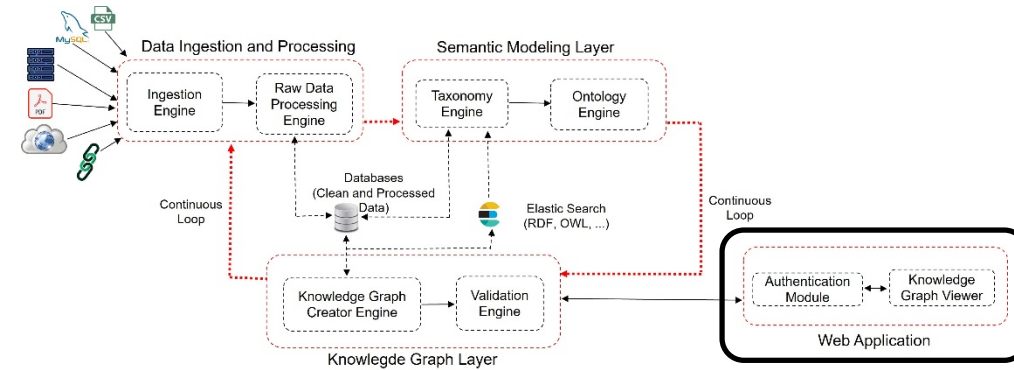
Knowledge Graph Layer



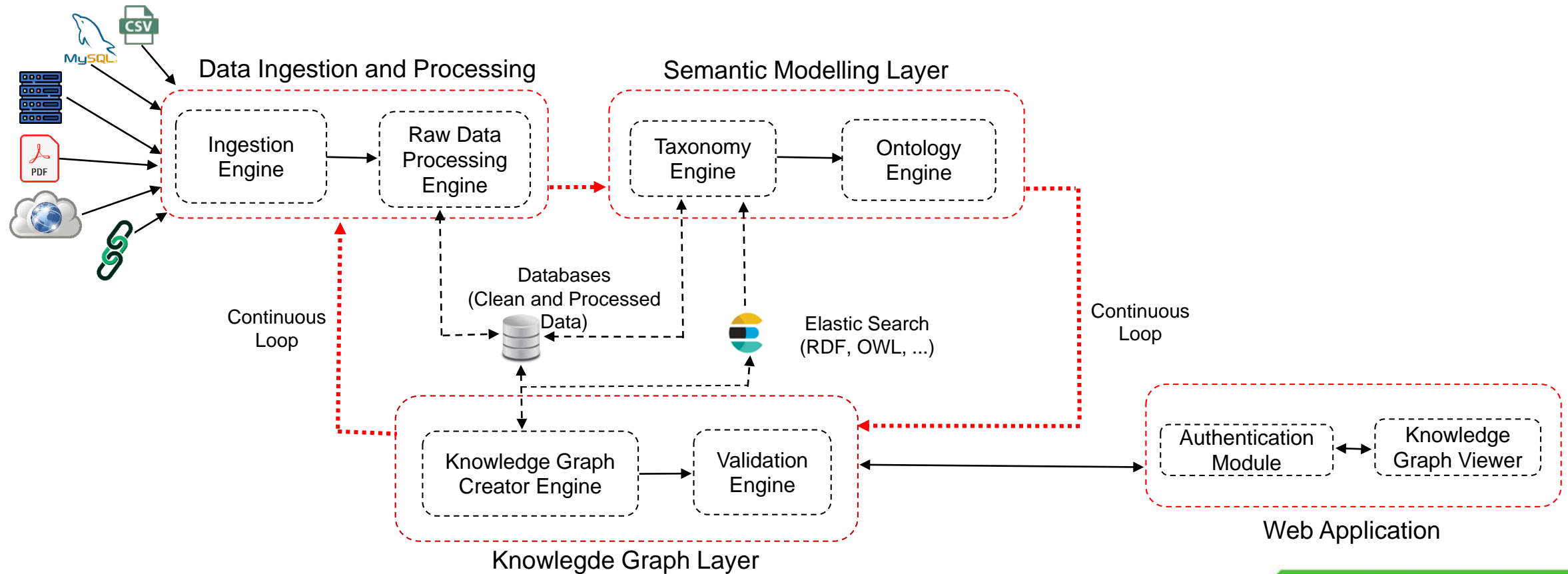
Web Application Layer



Web Application Layer

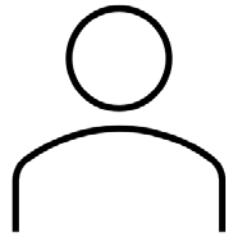


Information Management System



Thank you.

Contact Us



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