

Decision Support Tool for Selection of SSbD Coating Alternatives

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Introduction

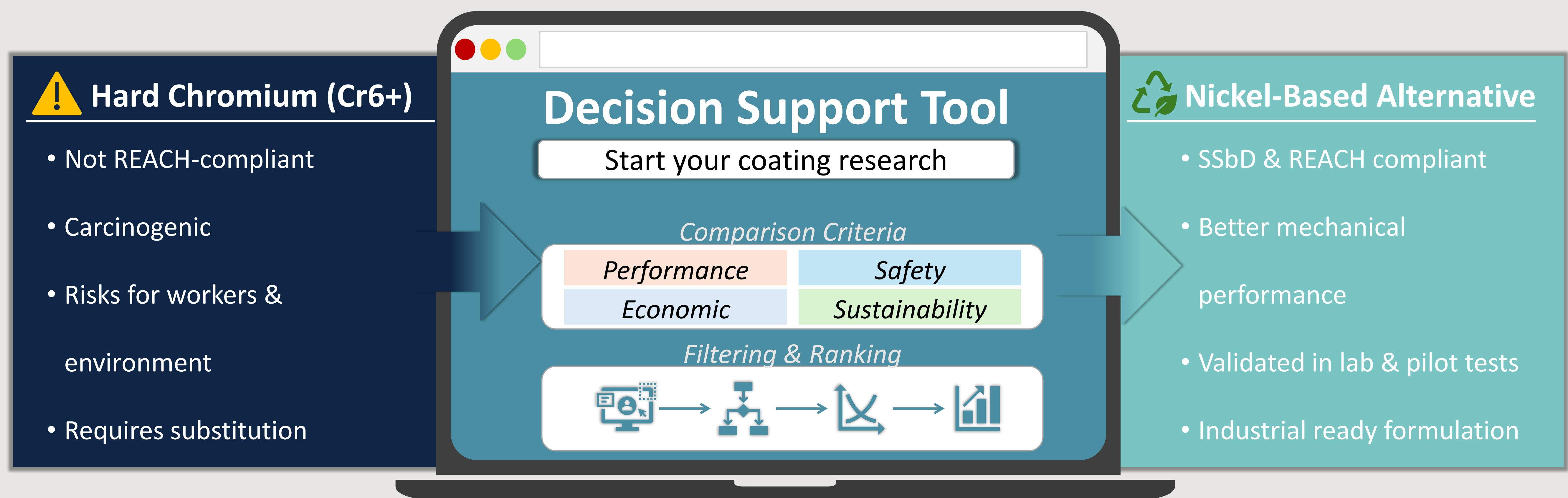
Regulatory pressure is increasing as hazardous chemicals are progressively restricted under REACH. Hard chromium coatings, although valued for their hardness and wear resistance, rely on chromium trioxide (Cr⁶⁺), a carcinogenic substance listed in Annex XIV. Its continued use requires costly authorization, pushing industry to identify safer, compliant alternatives.

The **MOZART project** develops nickel-based coatings that match or exceed the performance of hard chromium. These formulations were validated on gears, piston rods, and stamping dies through coordinated work across EU partners.

Methodology

The **Decision Support Tool (DST)** integrates MOZART project data (technical, environmental, safety, and economic), upscaled to pilot scale, into a unified framework for transparent comparison of formulations and end products.

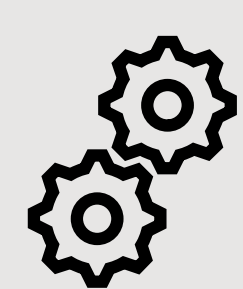
The tool offers two main features: **Optimisation**, where harmonised scenarios are ranked based on user-defined priorities, and **Customization**, where users configure materials and process inputs directly. Both rely on user-centred weighting to balance performance, sustainability, safety, and cost. This structure enables informed decision-making and accelerates the adoption of REACH-compliant nickel-based coating solutions.



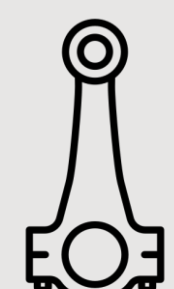
Features of the DST

Optimisation

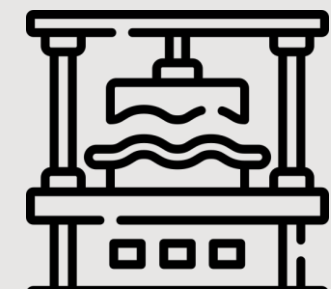
The **Optimisation Feature** uses scenario-based analysis and **multi-criteria decision modelling (MCDM)** to compare coating options. Each scenario represents a harmonised lab or pilot setup. The user selects one of the three validated end products (gear, piston rod, stamping die), and the tool evaluates only the scenarios relevant to that component.



Gears

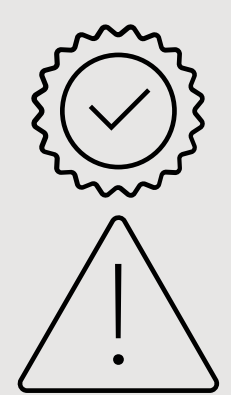


Piston rods

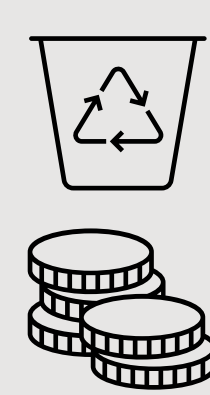


Stamping dies

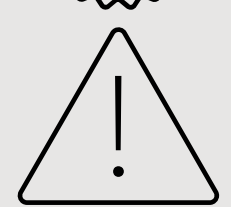
The tool applies a **Weighted Sum Model (WSM)** to rank scenarios according to user-defined priorities. The scoring considers Operational Expenditure (OPEX), LCA impacts, Hazardness, Hardness, and Energy use. Data processing follows an **SSbD-aligned scoring system**, with hazard levels ranging from Low to Very High and LCA scores reflecting improvements relative to hard-chromium replacement benchmarks.



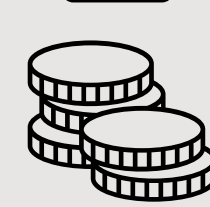
Hardness



LCA Impact



Hazardness



OPEX

Economic



Performance



Safe



Sustainability



Customization

The **Customisation Feature** allows users to define their own coating setup, making the tool applicable to any component or formulation beyond the three validated end products. Users specify the surface area and desired coating thickness and select the formulation they wish to evaluate. The tool calculates the required coating volume and material demand based on density and solids content, enabling flexible and highly replicable assessments across diverse applications.

Number of Units

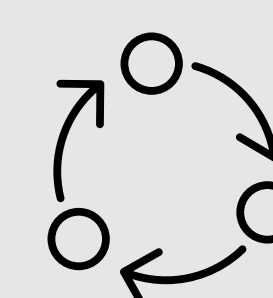
Coating Thickness

Surface Area

Formulation Selection

The DST automatically distributes the total coating mass across all formulation ingredients using predefined ratios. Each ingredient's mass is used to calculate environmental impacts and cost based on LCA factors and price per kilogram. The scoring follows SSbD-aligned principles, using hazard scores, LCA impacts, and material cost as the key indicators. Unlike the Optimisation Feature, hardness data are not included, as formulations are **user-defined** rather than experimentally validated.

New Coating Formulation



Flexible Across Any Product

Conclusion

This Decision Support Tool provides a clear framework for comparing coating options and supports informed decisions that balance sustainability, performance, and cost.

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