Air traffic is growing fast and is expected to double by 2036. Considering the CO_2 emissions generated by such traffic growth, the aerospace industry is strongly determined to decrease greenhouse gas emissions by developing new technologies. To fulfill European Union regulations, jet engine blades are presently used, and future components have to work in the stoichiometric temperature of combustion. Extreme temperatures would also be met during acceleration stages of supersonic flights, which are the future of commercial aircraft or military applications such as interceptor fighter jets, missiles, and target drones. Without the development of new materials able to work in extremely high temperatures, the future of supersonic flights and exploration of outer space cannot be realised. Single crystal (SX) Ni-based superalloys are currently used at a maximum temperature of up to 1100–1150°C during service of civil and military aeroengines thanks to a combination of both good environmental resistance to corrosion and excellent mechanical properties. A common feature of cast Ni-based superalloys is a high volume fraction of the γ' precipitates at temperatures up to 1000°C. *However, strength rapidly decreases above 1000°C due to a decay in precipitates volume fraction, high diffusional rates, and directional coarsening***.** The superalloys' mechanical strength mainly depends on these precipitates' volume fraction, morphology, size, and chemical composition. The design of the next superalloys generation that would display impressive creep resistance and surpass current service temperature is presently constrained by the γ' phase stability. **Developing Ni-based superalloys that maintain microstructural stability at operating temperatures above 1150°C necessitates the exploration of new compositional domains.**

The development of SX superalloys' chemical composition and manufacturing technology, which increases the gas temperature, is driven by the design of High Pressure Turbine Blades in jet engines. Unalloyed γ'-Ni_3Al precipitates begin to coarsen significantly at temperatures as low as 645°C. Theoretically, when refractory elements such as Ti, Ta, Hf, Re Ir, and Pt are added, the γ' precipitates are stabilised up to higher temperatures. To date, control of γ' stability has been accomplished primarily via refractory additions to Ni-based superalloys without detailed consideration of all platinum group metal (PGM) elements. Research on the microstructure stability and strength of SX Ni-based superalloys containing PGMs has focused mostly on rhenium and ruthenium additions. Limited investigations of Pt-modified Ni-base superalloys demonstrate impressive high-temperature mechanical and intrinsic oxidative properties at 1150°C. However, it was not investigated in detail, and a lot of **research gaps still exist**. To achieve high strength, the SX Ni-based superalloys are generally designed to have a microstructure consisting of 60-75% of the cubic-shaped γ′ precipitates at room temperature. The optimal volume fraction of γ', their morphology, and initial size can be achieved by chemical composition modification and complex heat-treatment. Keeping **a high volume fraction at elevated temperature is one milestone** in the fabrication of components for extremely high-temperature applications (e.g., supersonic flights or exploration of outer space).

Thus, the **main scientific** goal is to develop a **process-microstructure-properties relationship** for fabricating **Pt-containing SX Ni-based superalloys** with very high thermal stability above 1150°C. Computer modeling and experimental analyses on fundamental microstructural phenomena governing the formation of γ' precipitates characterised by desirable stereological parameters, stability, and resultant creep resistance will be carried out.

Moreover, **the main technological goal** is to design and produce Pt-containing SX Ni-based superalloys characterised by extremely high creep properties, high oxidation resistance, high hot corrosion resistance, and stable microstructure at elevated temperatures. The following function variables will be tailored to control the microstructure of manufactured SX Ni-based superalloys:
(1) the initial amount of the platinum;
(2) parameters of the super solvus solution heat treatment and aging heat treatment;
(3) degree of microstructure degradation dependent on the exposure temperature.

Therefore, the **research question** is: "*Can we produce the Pt-containing SX Ni-based superalloys with stable microstructure, high oxidation resistance, high hot corrosion resistance, and creep strength exceeding that of commercial Pt-free materials?* The development of the final fabrication procedure requires fundamental research.

In order to **provide the answer**, the **usefulness** of Pt-containing SX Ni-based superalloys as HPT materials will be evaluated by examining their microstructure and resultant performance properties (namely, oxidation resistance, hot corrosion resistance, and creep strength) in a comparative study with commercially available superalloys. ***Finally, exemplary high-pressure turbine components made of Pt-containing SX Ni-based superalloys with pre-defined (application-oriented) size and geometry will be provided as proof of concept.***