Engineering
with a difference

Feasibility study of additive manufacturing (AM) center of excellence in Finland

Etteplan AMO Team

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AM in Finland

- Currently, there are none AM service bureau with needed equipment and competence to provide manufacturing services for **critical applications** in Finland.
- Finland is missing innovation center similar to **AMEXI** in Sweden
- There is an opportunity for a **new 3D printing service bureau** or consortion with credibility in Finland

HX program Industrial value

- Finland will replace its Hornet fighters in 2021, and the bidding process for the program is now ongoing.
- The primary objective of industrial participation is to ensure the military security of supply of defense industry products from Finnish and foreign manufacturers and the availability of critical technology in any circumstances. The secondary objective is to ensure the development of Finnish technology and competence in the future as well.
- The total value of the Industrial participation (IP), is approximately EUR 2-3 billion.

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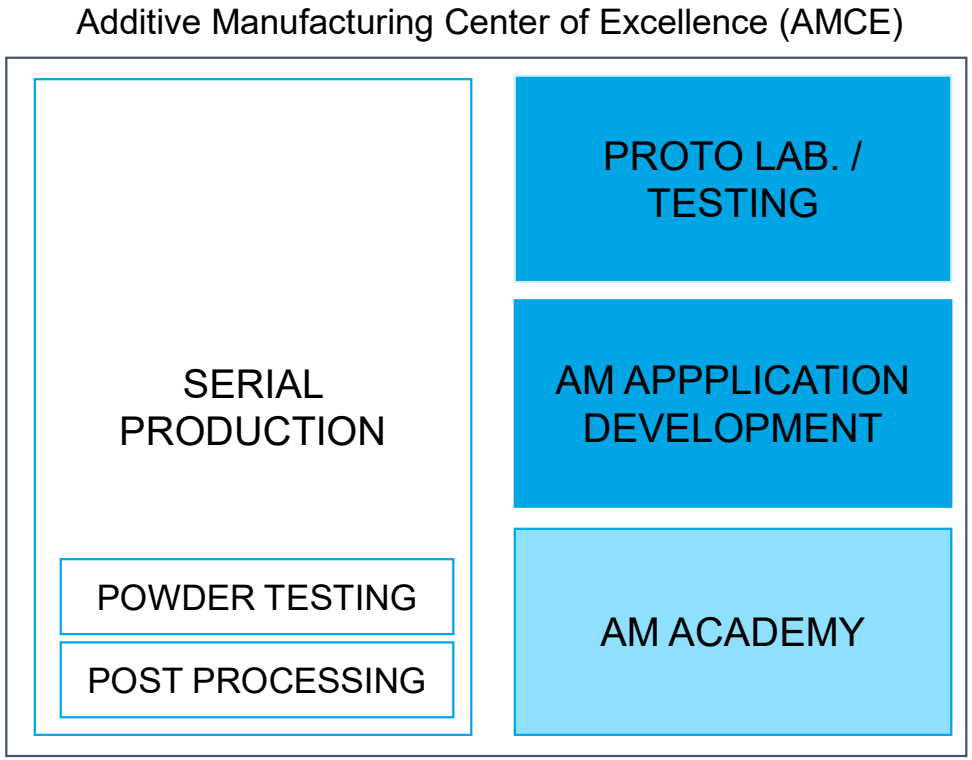
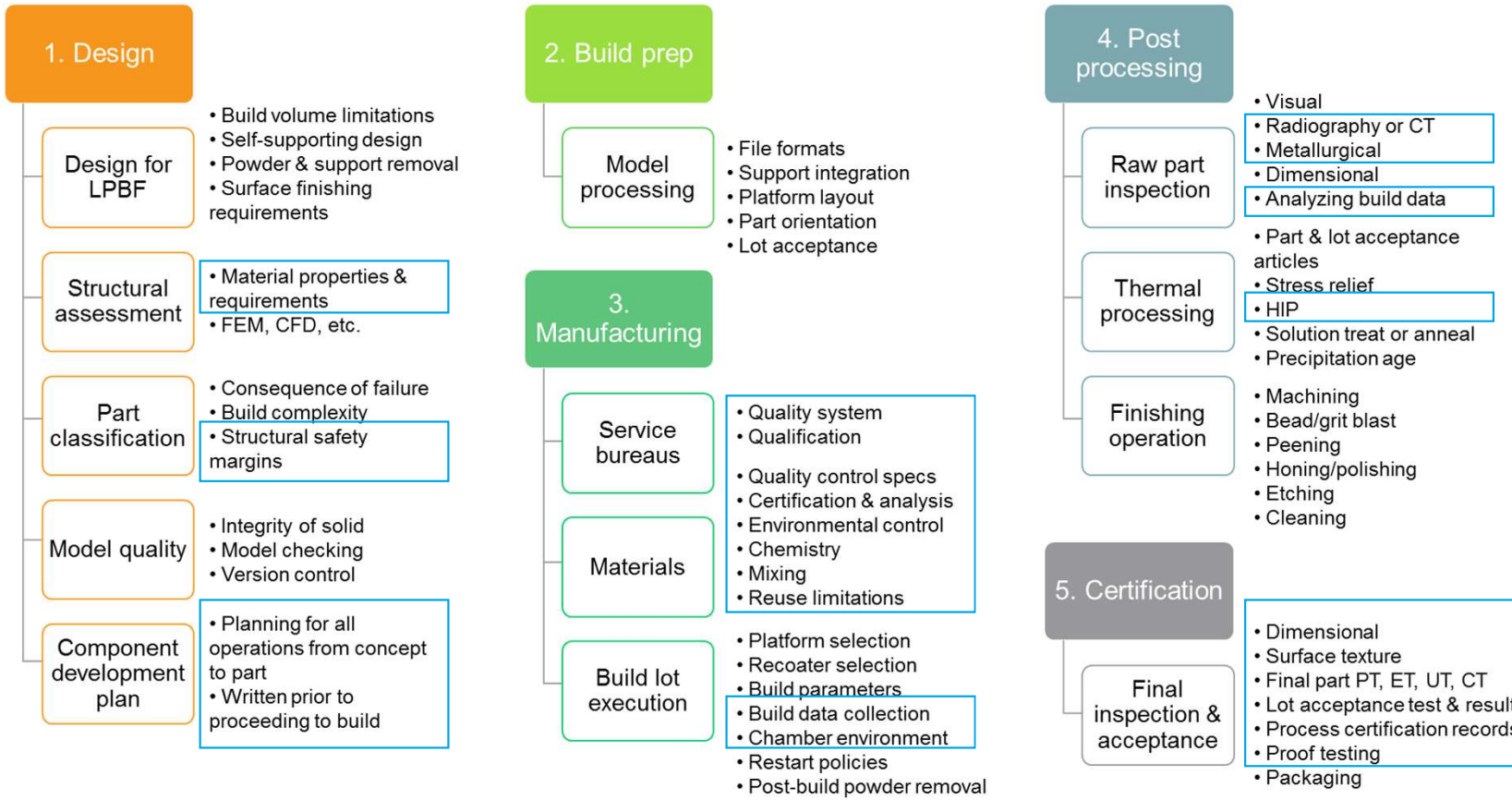
Overview

- HX-program opens an opportunity to create industrial-scale additive manufacturing expertise in Finland, which serves and develops Finnish defense and security industry expertise, and also brings technical expertise to the use for other industries.
- The AM Center of Excellence can accelerate the industrial adoption of additive manufacturing and help bring a new generation of innovative engineers and products to the market. The excellence center will fill the gaps in additive manufacturing knowledge and this is what Finnish manufacturing needs to take full advantage of the new technology.
- Companies in HX AM Consortium need to commit to do what it takes to reach the highest level in AM, production of critical aerospace components in collaboration with others and with whole Finnish AM ecosystem.

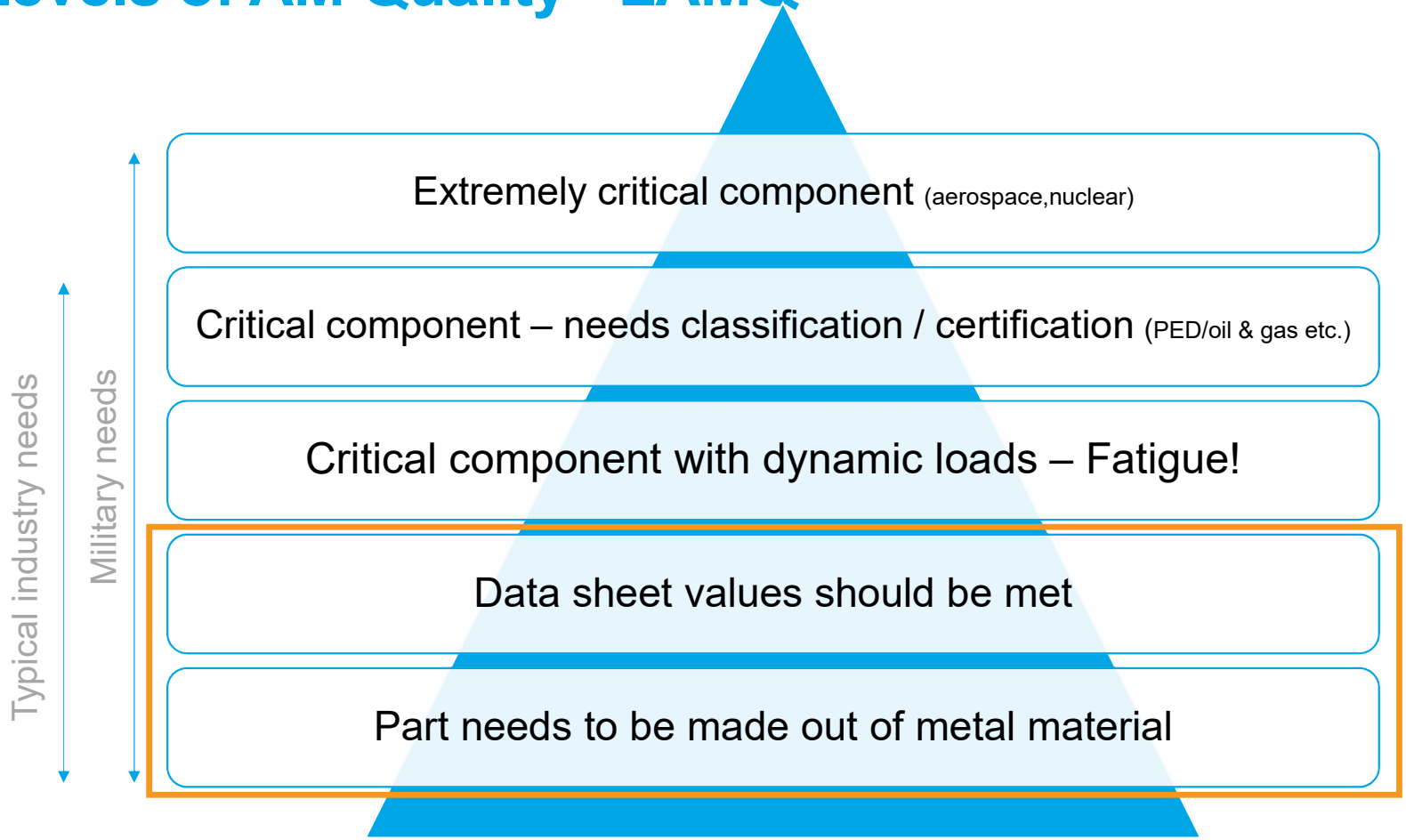


Necessary steps in creation of a qualified component created by LPBF

Missed competencies / lack of full understanding



Levels of AM Quality - LAMQ



Finnish AM service bureaus

Research and Machine Base in Finnish Research Centers

- Large number of good research on-going
- Metal AM machinery in academia is distributed well geographically and still increasing
- Level of AM education varies in academia
- More education needed to universities and technical colleges for national spreading of AM
  - Design rules
  - AM techniques
  - Hands-on experience
  - Exercises & operating the machines

Research Center	Location	Machine
Aalto University	Otaniemi	EOS M290
EOS Finland Oy	Turku	Too many to list
LUT	Lappeenranta	EOS M270, EOS M290
University of Oulu in cooperation with Nivalan Teollisuuskylä	Nivala	SLM 280HL
JAMK University of Applied Sciences	Jyväskylä	LPBF (planned for 2020)
Savonia University of Applied Sciences	Kuopio	Metal X (2019), LPBF & DED (planned for 2020)
SASKY	Sastamala	SLM 125HL
Turku University of Applied Sciences	Turku	LPBF (planned for 2020)
TUT	Tampere	DED (wire-feed)
University of Vaasa	Vaasa	LPBF (planned for 2020)
VTT	Otaniemi	SLM 125HL

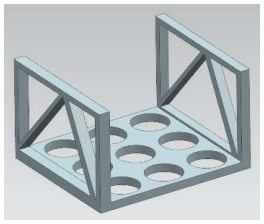
Commercial Metal AM in Finland

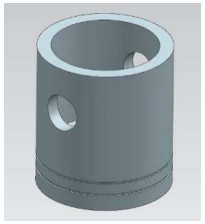
- Top level quality print service not available
- Laser Powder Bed Fusion (LPBF) only
- Limited production capacity
  - 5 medium sized metal AM machines in whole of Finland
- Advanced post processing not existing in Finland
  - Hot Isostatic Pressure (HIP)
  - Automatic support removal (Hirtisation)
  - Improved surface finishing (Hirtisation, MMP, abrasive honing..)
- So far three Finnish companies publicly announced metal AM machine acquiring

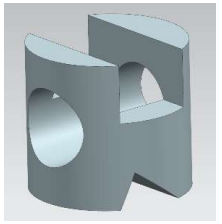
Service Bureau	Location	Machine
3D Formtech	Jyväskylä	EOS M290
3D Step	Tampere	SL 280HL Twin (400 W)
Delva	Hämeenlinna	EOS M270, EOS M290
HT Laser	Keuruu	SLM 280 2.0 Twin (700 W)
Materflow	Lahti	Concept Laser M1, SLM 280HL

Company	Location	Machine
Lillback Powerco	Härmä	3D Systems
Valmet Oyj	Sundsvall, Sweden	EOS?
V.A.V. Group	Ii	SLM Solutions

Service bureaus annual theoretical volume

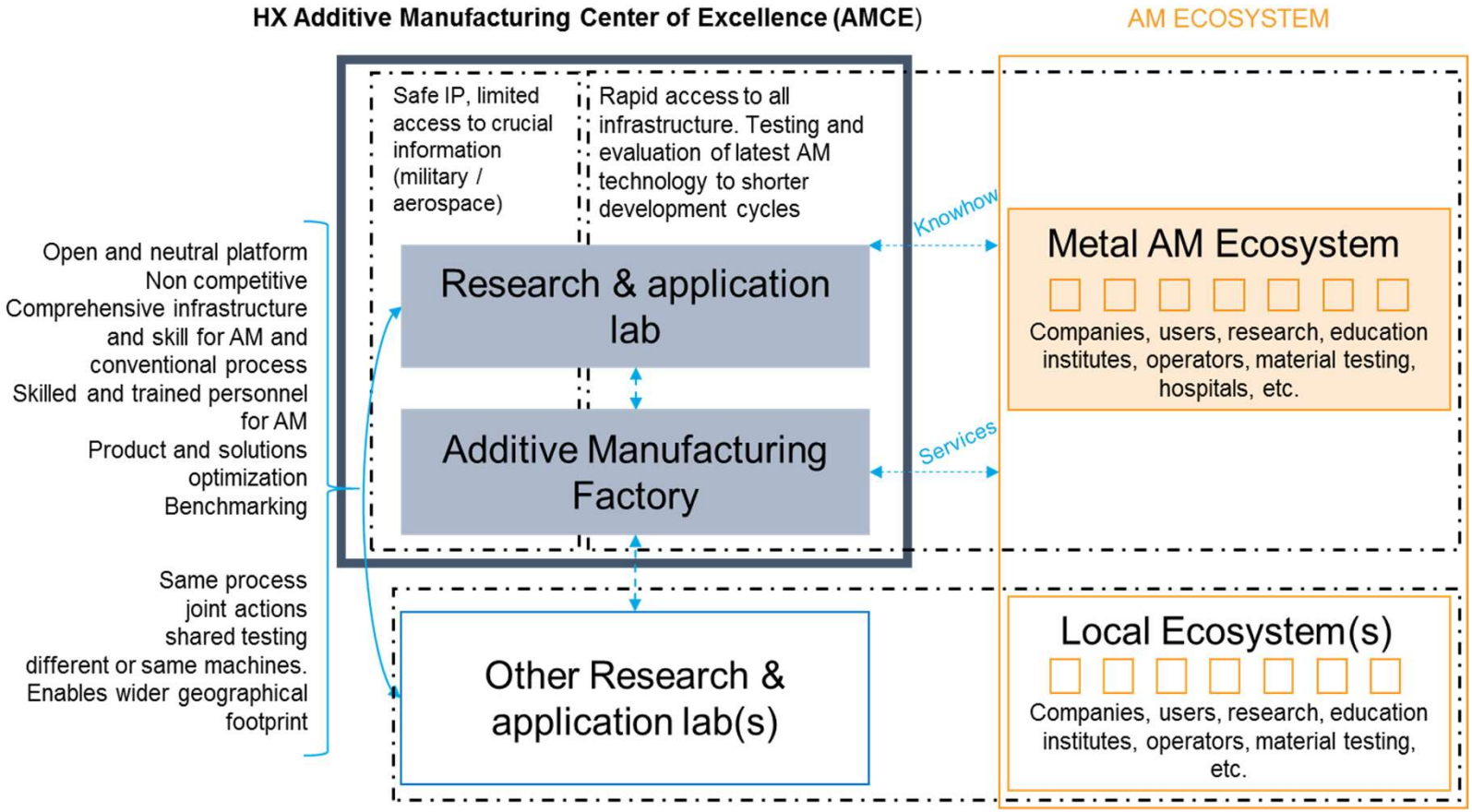




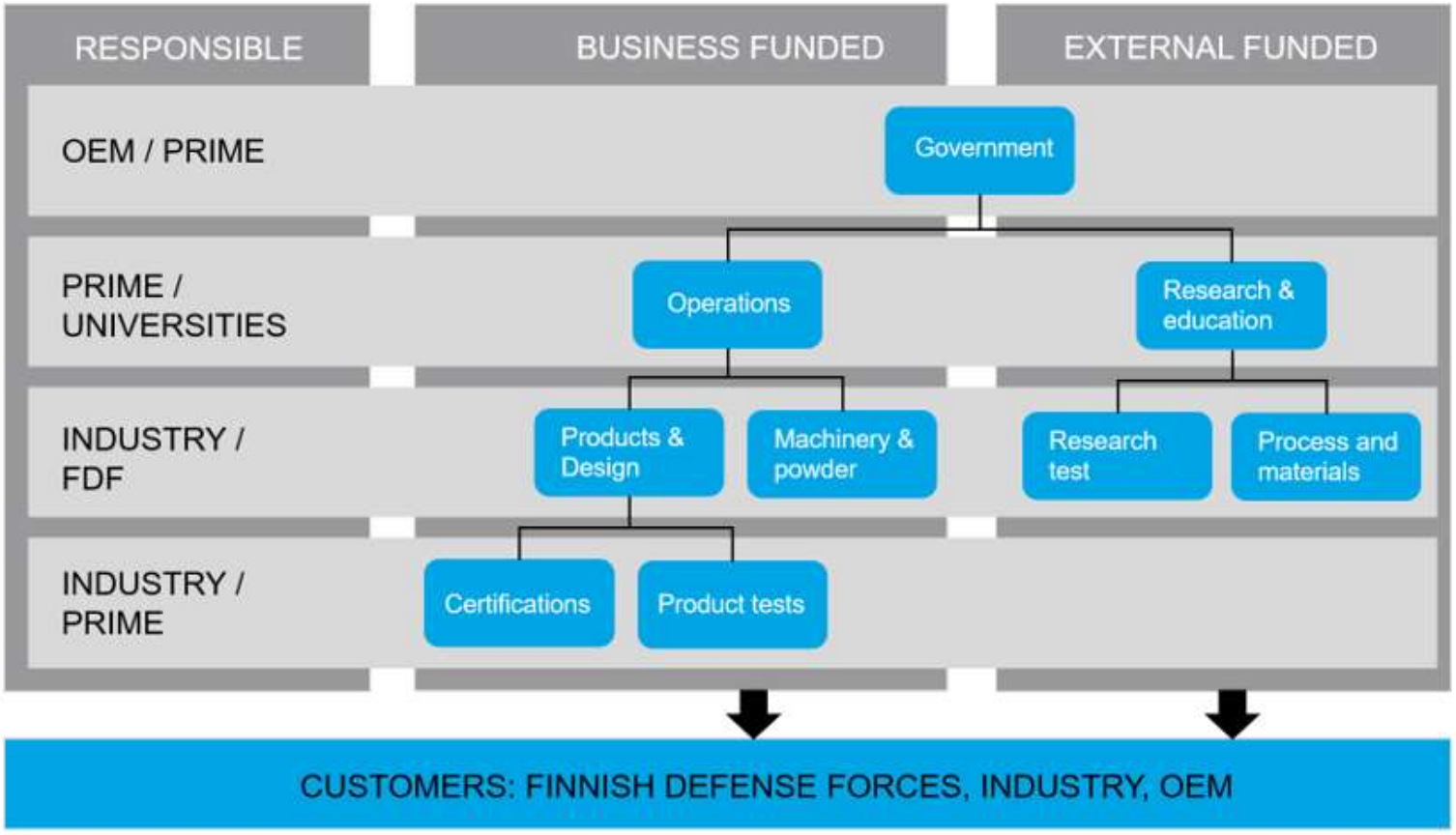


Example components with detailed information on their size, volume and print time.			
Component	Bracket	Piston	Block
Size	140 x 120 x 85 mm	Ø50 x 56 mm	Ø185 x 170 mm
Volume	115 cm^3	57 cm^3	2180 cm^3
Components per one build	6	13	1
Estimated print time per piece	13 h	4,5 h	180 h
Potential annual volume	420 pcs	1220 pcs	30 pcs
combined theoretical production volume that Finnish metal AM service bureaus	3336 pcs.	7500pcs.	258 pcs.

Consortium role



Overview of roles



Overview of roles in HX AMCE consortium.(Patria Aviation Oy, 2019)

Benefits for Finland

- Increases competitiveness of Finnish companies
  - Increased AM know-how leads to new innovations
  - Better and more cost-competitive products
  - Increased creation of added value
- Creates foundation for completely new industry in Finland
  - Opportunity for Finland to be an early adopter of AM
  - High-technology manufacturing - increased creation of added value
  - Huge export opportunity due to the nature of AM
  - Lost traditional factory jobs can be replaced by new AM factory jobs
- New high-paying jobs created
- Provides excellent facilities for high level research work
- Crucial contribution to security of supply

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