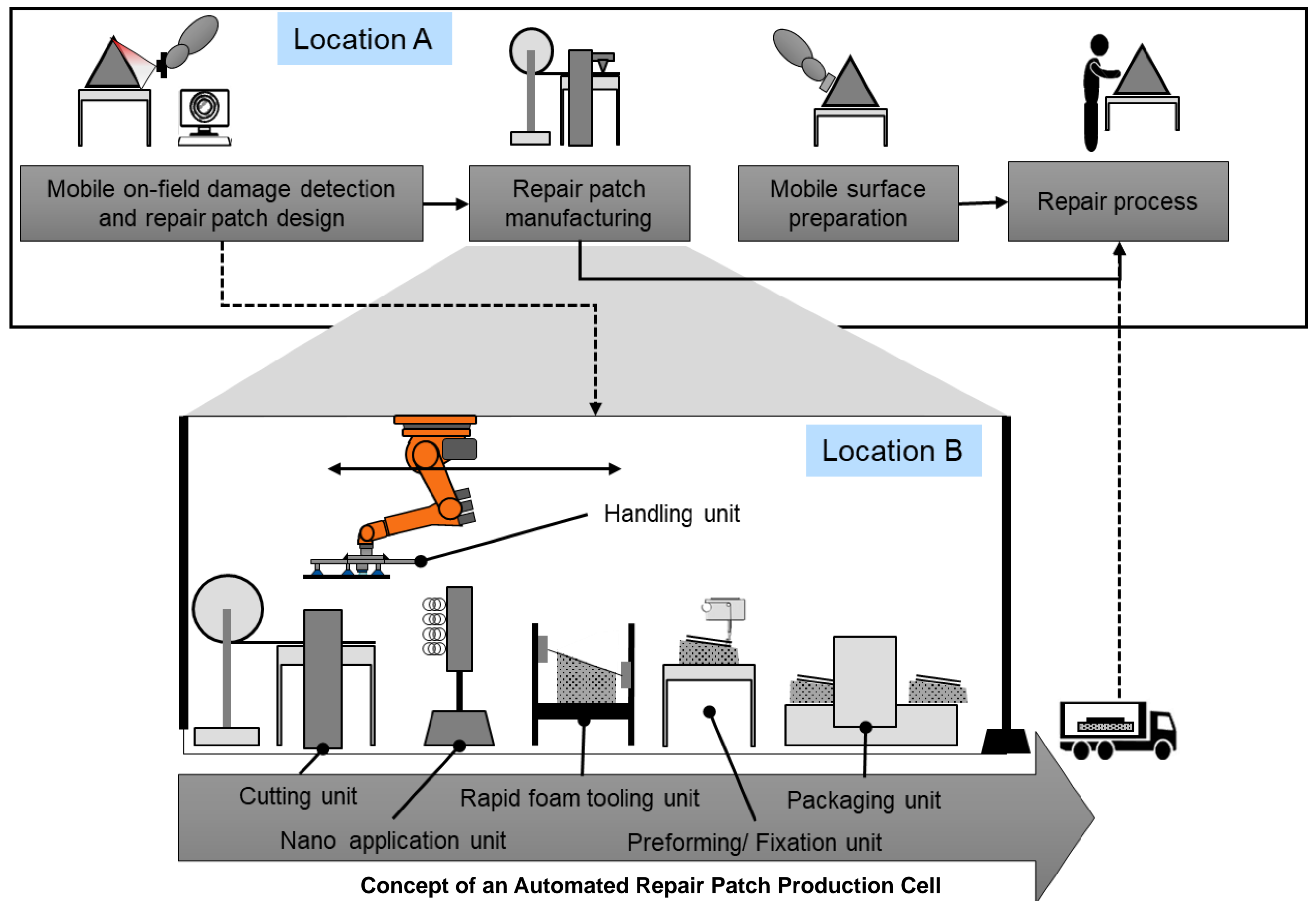


Automated Patch Production for Composite Repairs

Aim: To develop a process chain for automated production of nano-particles based enhanced repair patches for composite parts

Concept and Methodology

- Currently, composite repairs are being carried out manually and hence are prone to poor quality standards and increased process times. Currently, these patches can take 7 days for production and installation.
- This project develops an automated production cell for manufacturing of such composite repair patches.
- In order to increase the residual strength, a nano-particle layer is applied between the composite fibre layers.
- The primary application is aimed at production of aircraft repair parts.
- Key challenges to be addressed include the reduction of production time.



Scanning Unit	Cutting Unit	Handling Unit	Nano- Application	Tooling Unit	Packaging Unit
<ul style="list-style-type: none"> Scanning of the surface geometry of the damaged section. Damage evaluation and characterisation. Laser system: <ul style="list-style-type: none"> Nanosecond pulsed fibre laser 100W average power at 100kHz Focused on a diameter of 50 microns 70kHz measurement rate, Intensity 100%, Data 9999, Quality threshold 35 	<ul style="list-style-type: none"> Three cutting methods are evaluated. Rotating circular knife, Electrically Oscillating and Ultrasonic knife. Rotating circular knife had the highest quality for lab scale tests. Ultrasonic knife can be used with reasonable quality metric for larger diameters. 	<ul style="list-style-type: none"> A robotic integral head consisting of needle grippers was developed for handling of the textiles. Three configurations for the design of this unit were evaluated. Final configuration, which is attached to a robotic head is below. 	<ul style="list-style-type: none"> Nano-application unit is developed by Sabanci University. It consists of a spraying unit which lays down the nano-particles on the fabric. Prepreg or dry fibre materials can be used. 	<ul style="list-style-type: none"> Hot wire cutter with integrated milling head is used for production of foam tooling units The repair patch is fixed to this tool using tufting technology. 	<ul style="list-style-type: none"> Packaging unit consists of an automated vacuuming unit used to shrink wrap the repair patch.

Conclusions

- An automated production line for manufacturing of repair patches is developed and demonstrated.
- The processing time required for manufacturing custom repair patches is reduced down to under 48 hours.
- Quality metrics as per EASA / FAA standards are achieved.