1- What are screw piles?
Screw piles, also known as Helical piles or anchors consist of a central steel pipe (core) with one or more steel screw flights/flanges welded near the toe of pipe and sometimes at intervals along the shaft.

2- Why screw piles?
- Quick, easy installation (Fig. 1)
- Easier field modified or adapted to suit varying soil conditions
- No vibration/low noise
- No spoil to Remove
- High capacity/weight ratio (i.e. high efficiency) by achieving optimal flange spacing:

3- What are their barriers to use?
- Piles need to be made much larger than their current onshore sizes
- Optimal geometry (e.g. number and position of flanges, size of flanges and core, etc.) for typical offshore loadings is not clear (Fig. 2)
- Required installation forces and torques need to be understood to design installation equipment
- Uncertainty over performance under cyclic loading (Fig. 3)

4- Preliminary numerical studies
- Flange spacing (S/Dp) optimised for monotonic loading (various flange/core diameter ratios), Fig. 4a.
- Axial monotonic capacity can be increased 3-4x compared to core alone (conventional pile)
- Lateral resistance can be increased up to 20% with near surface flange (Fig. 4b)

5- SUPERGEN project
Aims and objectives
- Conduct centrifuge modelling to physically simulate installation of screw piles in flight using a recently commissioned actuator (Fig. 5)
- Determine the maximum torque and force requirements for installation of large diameter screw piles and geometry optimisation.
- Conduct in-flight monotonic and cyclic load testing under loads typical of offshore facilities at various life stages
- Assemble a database of high quality load test data for validating numerical models of:
  - Installation (using Material Point Modelling, at Durham University)
  - Peak cyclic load performance (using PLAXIS)

6- Centrifuge modelling with single installation and loading operation
- The effective confining stress and stress history effects the mechanical properties of the soil and the responses to installation and service loading (Fig. 6)
- The centrifuge is used to provide appropriate scaled insitu stress levels
- Problems with previous studies due to 1g installation, (Fig. 7)

7- Installation / loading rig
- A 2-D servo actuator has been manufactured in the UoD having 510kN capacity, maximum speed 1.0mm/s and up to 3000mm stroke (Fig. 8).
- Two servo motors are used, one (master) to translate the rotary motion into linear motion for vertical displacement via screw ball system and the other (slave) is used for screw pile installation.
- Gears were used on both axes to increase the torque supplied by the servo motors.
- A Combined torque and load cell transducer is used to measure both parameters during installation in-flight.

8- Geometry effects and general observations for a single flange only
- Wing ratio, Dp/Dc=1 is the no flange case.
- Reduction in torque and capacity for low diameter flanges (Fig. 9 and 10)
- Single flange at the bottom of the screw pile interests to industry (low cost) but may not give the required capacity enhancement anticipated from multiple flanges.

8- Conclusion
- Upscaling onshore screw piles for offshore use is the next challenge.
- Screw piles capacity may be 2 to 3 times that of conventional piles (i.e.driven piles)
- Screw piles installation in-flight (N=9g) is more realistic than 1g installation (required centrifuge).
- The measured torque and the capacity are influenced by the screw piles geometry which requires further investigation for optimised pile geometries.

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