Supplementary file (available upon request)

S1: Lean practices implementation in the case companies (*detailed form of the summary provided in Table 3)*

Phase	Pre-implementation	Implementation	Post-implementation
Case A (Practices in shop floor processes)	TQM: Quality gates and testing as part of processes (M); Well established use of visual tools in production planning and shop floor (H) JIT: Kitting operation just before assembly (L) HRM: Cross-training programs (L) LP: Kanban boxes used for common small components (L) STD: Use of standard workstation elements; written procedures for making offers but not well implemented (M); Quality gates, kitting established (L) TPM: (The company considers that this is not so major issue for this company as most operations in the specific ETO business are manual assembly related (L)	TQM: 5Why approach and Kaizen meetings (M) JIT: Workstations based on major product families (H); Resource levelling attempts at shop floor; design stage still bottleneck (M); Quick changeover techniques (L) HRM: Operators take turns for kiting and other activities as appropriate (M); Use of engineering skills to reduce inventory (M); Initiatives to use multi-functional teams (L) LP: Reduced need for incoming material inspection (L) STD: Product family by size (L); Palletising and kitting started but interrupted (L)	TQM: Process capability measurement (L) JIT: Initiatives for bottleneck removal exist but without strong integration (M); Some initiatives for reduction of cycle times in engineering and production (L)
Case A	SID: Close and long term relationship with	LP: Reducing order size yes, but no structured	CIP: Customer feedback

Phase	Pre-implementation	Implementation	Post-implementation
(Practices in transactional processes)	suppliers (H)	process (M); Short order placement, mainly due to input diversity (L) CIP: Customers often initiate and engage throughout until an order is delivered (H) SID: The company says that major suppliers make improvements rapidly (H); challenges with supplying plants at group level (L); No definitive engagement of suppliers on improvement commitments (L)	unstructured except for change request, delay or defect (L)
Case B (practices in shop floor processes)	TQM: Strong focus on how the customer perceives process and product quality (H); Suitable visual display boards, assembly floor area markings, sequential arrangement of tools and components (H); Established training, experimentation and measurement of improvements at shop floor (H) JIT: Macro cells and micro shops implemented for different product families (H); Receiving areas for products defined based on Kanban sizes (M); Kitting	JIT: Continuously worked to reduce cycle times and lead times (H); On the shop floor flow is kept as constant as possible with some WIP to manage customer changes (M) HRM: Strong level of multitasking (rotation and enrichment of jobs) (H); Workers are encouraged to question and improve traditional approaches (M) CIP: Technical training centre also used for customers (M) STD: Working with the disabled further helped	JIT: Quick changeover for testing with flexible and higher capacity test rig (H)

Phase	Pre-implementation	Implementation	Post-implementation
	operations to improve flow (M) HRM: Arrangement of multifunctional cells (M); Formal cross functional training for employees (M) STD: Standard workstation, tooling and components for assembly paced in carts (H)	simplify and standardise shop floor procedures (M) TPM: Acquisition of technology that adds to the flexibility and availability of testing (H)	
Case B (practices in transactional processes)	TQM: Started lean journey with the application of quality management programs and training (M); Thorough work in VSM analysis involving suppliers to guide process improvements (H) HRM: Personnel are: cross-functionally trained and experienced at front line unit (H); Six Sigma certified at different levels (M) LP: No need of inspection for castings made at different company plants; only outsourced castings inspected (L); Kanban boxes used in dispatch for assembly (M) CIP: Front line creates a direct and single point of communication to the customer (H);	LP: Reduced need for bulk buying with negotiation (M); Front line unit enabled to handle purchases for specific projects with shorter order placement processes (M) CIP: The customers have the possibility to engage in discussion and get advice for better value offers including technical details (M) SID: Some challenges from corporate level to focus on prices rather than partnership (L) STD: The supporting engineering department provides training and standards to improve the customer engagement and shop floor efficiency (H); Some suppliers deliver components directly	TQM: Fast analysis of capacity and backlogs to expedite outsourcing decisions (M) JIT: The plant's processes pull from customer orders (M); Front line unit reduced the need to pass paper work to all concerned functional units during negotiations (H); JIT supply by working together with some partners (M) CIP: Discussion with

Phase	Pre-implementation	Implementation	Post-implementation
	Partnership and long history with important customers (M) SID: Close relationship with suppliers including shared meetings to streamline production plans (H); Training suppliers to enable them fulfil company demands (e.g. in terms of quality and delivery) (M)	to the assembly area; company aims to get all deliveries according to assembly plan (L)	customer of problems discovered (M)

Note: - TQM= *total quality management and visual management;* JIT= *just-in-time/flow*; *HRM= human resources management, LP= lean purchasing, CIP= customer involvement and partnership; SID= supplier involvement and development; STD standardisation*; TPM= *total productive maintenance*
- Practices are stated in the earliest phase they have been observed

S2: Observed customisations of lean practices implementation in the ETO case companies compared to repetitive manufacturing

Practice bundles	Underlying practices	*Case A*	*Case B*
TQM	Quality management programs		
	Formal continuous improvement programs	Continuous improvement in engineering (attempted) More room for experimentation due to diversification in orders (poorly utilized)	Continuous improvement in engineering enhanced through well designed training
	Process capability measurement		
	Use of proper visual tools		Visual location markers are used to confirm that all necessary parts are in place before starting assembly work. These marked areas also act as information Kanbans because the full ones represent shop floor (assembly and testing) capacity utilization level. Further attempts noticed to put the parts in the sequence they are to be assembled in a form of 3D grid.
JIT	Cellular layout		More room for experimentation due to diversification in orders; the natural context itself invites for experimentation and continuous improvement
	Bottleneck identification and removal	Extended info on Kanban cards with predefined milestones;	Along with the kitting for the daily work, macro cell workers are working on eliminating cartoons, wood pallets whatever

Practice bundles	Underlying practices	*Case A*	*Case B*
			to further reduce area required and improving flow.
	Cycle time reduction		Reorganisation (including micro shop and macro cell) based on the lead time in different products [families], or processes given vertical integration has been observed.
	Reengineering of processes	Kitting (palletizing parts and material for each unique order) and receiving these kits directly from warehouse to complete assembly without stop	Frontline unit reduced the need to pass paper work to all concerned functional units during negotiations
	Quick changeover techniques	Standard items with long external lead times kept in stock strategically; Elimination of non-value adding activities while keeping some room for flexibility	
HRM	Job rotation, design, and enrichment		
	Formal cross-training programs		
	Problem solving groups and employee involvement	Use of engineering skills to reduce stock levels	

Practice bundles	Underlying practices	*Case A*	*Case B*
	Flexible cross-functional work force		
LP	Reduced purchase order sizes		Catalogue based price negotiation with suppliers that reduce not only price change risks but also size of single order and the length of the order placement as frequent negotiations are eliminated
	Short-order placement processes		
	Reduced need for incoming material inspection		
CIP	Direct customer engagement in product offerings	Value identification and enrichment efforts with close customer relation.	Value identification and enrichment efforts with close customer relation.
	Customer feedback on different performances		
SID	Close contact and long term relationship	Supplier (key) regularly updates on lead time improvements based on product families; Key Suppliers (sub-contractors') put their plan in shop floor of company A for follow up;	

Practice bundles	Underlying practices	*Case A*	*Case B*
	Supplier development and certification		
	Improvement commitments from suppliers		Started activities so that suppliers would be able to bring parts to the kitting area, which further improves cycle times.
STD	Standardising processes and procedures	Progressive move on standardisation. Procedures for updating order details; Standardization (with customization) in concept and detail engineering activities in addition to shop floor Moving references defined;	Standardization (with customization) in concept and detail engineering activities in addition to shop floor; Moving references defined; key suppliers managing inventory at regular intervals …instead of predefined reorder levels
TPM	Maintenance optimisation techniques Preventive/predictive maintenance techniques		
	New process/technology acquisition		Acquisition strongly motivated by the need for flexibility needs