

The Supply Chain Management of Imported Slab to Tata Steel Port Talbot

ACHA7024 – Procurement and Supply Chain Management

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Abstract

The study investigates the international supply chain for steel slab imports to Tata Steel Port Talbot during the company's transition to Electric Arc Furnace (EAF) steelmaking. Employing Failure Mode and Effects Analysis (FMEA), the research identified and prioritised critical risks such as supplier shortages, shipping delays, and documentation errors, through the calculation of Risk Priority Numbers (RPNs). The findings indicate that several significant threats to production continuity exist. To strengthen resilience, six mitigation strategies were proposed, including supplier diversification, digital tracking, and strategic stockholding. Overall, the analysis underscores the importance of proactive risk management in ensuring a stable and sustainable slab supply throughout Tata Steel's decarbonisation process.

1. Introduction

Global steel supply chains are characterised by a high degree of complexity and are exposed to multiple risks arising from geopolitical tensions, transportation disruptions, and variability in the availability of raw materials.

Tata Steel Port Talbot is undergoing a major transformation from conventional blast furnace operations to Electric Arc Furnace (EAF) technology as part of its wider decarbonisation strategy. Throughout this transitional phase, the importation of steel slabs remains critical for sustaining production levels and ensuring the uninterrupted supply of material to downstream customers.

This investigation examines the international supply chain for steel slab imports to Port Talbot, with a focus on how potential disruptions may influence operational continuity and customer delivery performance. A Failure Mode and Effects Analysis (FMEA) is applied to identify and prioritise supply chain risks through the evaluation of their causes, consequences, and severity.

The research sets out six strategic measures designed to enhance supply chain resilience, thereby ensuring the consistent delivery of high-quality slabs and reinforcing Tata Steel's long-term sustainability and competitiveness within the global steel industry.

2. Supply Chain Mapping

Supply chain mapping is a systematic process used to visually illustrate the key stages, entities, and flows involved in the movement of goods and services, from the sourcing of raw materials to the delivery of the final product to the customer (Doyle, 2023). It provides a comprehensive overview of the interconnections between suppliers, manufacturers, logistics providers, and distributors, as well as the flow of information and finances throughout the network (K, 2024).

The use of supply chain mapping offers several advantages, including enhanced visibility across the entire supply chain, enabling the identification of potential vulnerabilities, inefficiencies, and critical dependencies (Mubarik, Ahmed, & Wasim, 2025).

Supply chain mapping also supports informed decision-making, strengthens risk management and resilience strategies, and facilitates effective responses to disruptions. Supply chain mapping also promotes transparency, highlights opportunities for cost reduction and sustainability improvements, and fosters stronger collaboration between supply chain partners and stakeholders (Dixon, 2025).

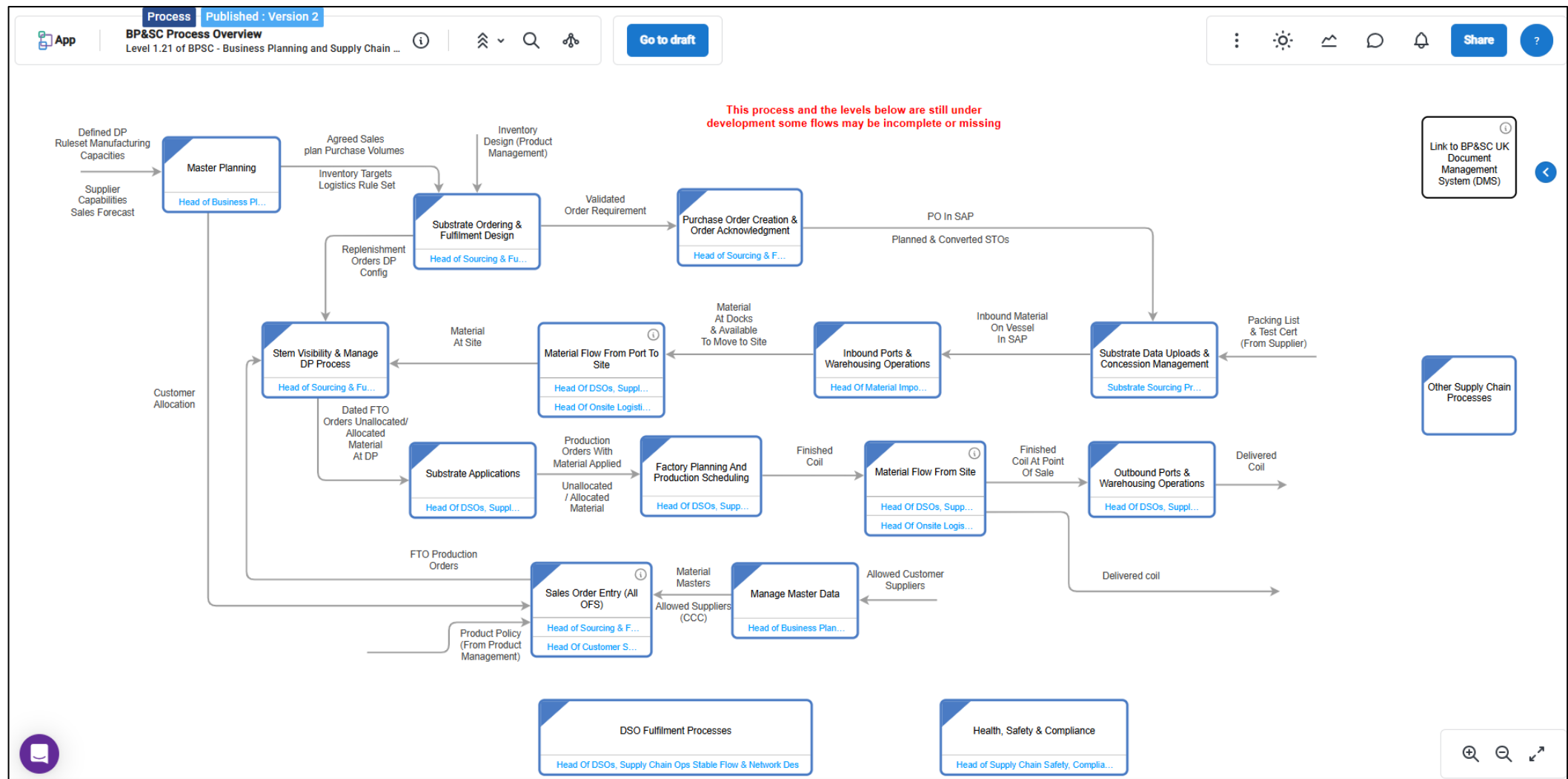


Figure 1 – Internal Supply Chain Map

The supply chain process at Tata Steel Port Talbot is structured to coordinate the efficient flow of materials and information from suppliers through to end customers. The process begins with strategic master planning, which establishes production capacities and aligns customer demand with operational capabilities.

This is followed by the design of substrate ordering and fulfilment systems, ensuring effective supplier engagement and the timely generation of replenishment orders. Once these orders are validated, purchase orders are created in SAP and translated into stock transfer orders, initiating the inbound logistics phase.

Materials are then received through port and warehouse operations, where key activities such as data uploads, concession management, and the verification of accompanying documentation, including packing lists and test certificates are completed.

The materials are then transferred from port facilities to the production site, where factory planning allocates them to specific manufacturing schedules. The resulting finished coils are processed through outbound warehousing and port operations to facilitate accurate and timely customer delivery.

Supporting functions, including sales order management, product policy oversight, and material master data maintenance, ensure system consistency and operational accuracy. Throughout the process, health, safety, and compliance activities uphold regulatory and organisational standards.

Collectively, this supply chain model reflects an integrated framework that aligns planning, procurement, logistics, production, and compliance to achieve a transparent and efficient operational flow.

3. Failure Mode and Effects Analysis

3.1 FMEA Overview

This study employs the Failure Mode and Effects Analysis (FMEA) framework to evaluate potential risks within the international supply chain for steel slab imports to Tata Steel Port Talbot. FMEA provides a structured and quantitative approach to risk assessment, enabling the identification of potential failure modes, the evaluation of their impact on system performance, and the prioritisation of corrective actions according to risk severity (Curkovic, Scannell, & Wagner, 2013).

The analysis considers the key stages of the slab import process, including supplier production, international transportation, port handling, customs clearance, and quality assurance. Each stage is assessed to identify potential failure modes, their underlying causes, and the consequent effects on operational performance. Risk evaluation is undertaken using three core parameters, Severity (S), representing the impact of a failure on operations or customers. Occurrence (O), indicating the likelihood of the failure arising and Detection (D), reflecting the probability of identifying the failure before it results in disruption. (Forrest, 2025).

The parameters are combined to calculate the risk priority number as shown in Equation 1, provides a quantitative measure of risk significance. Higher RPN values indicate greater levels of concern and guide the prioritisation of mitigation strategies. The resulting data are presented in an FMEA table, which serves as the basis for the subsequent evaluation of resilience enhancement measures (Snee, 2007).

$$\text{Risk Priority Number (RPN)} = \text{Severity (S)} \times \text{Occurance (O)} \times \text{Detection (D)}$$

Equation 1 - RPN Calculation

3.2 FMEA Table

		Alex Greenslade	FAILURE MODE and EFFECTS ANALYSIS On Import Slab Supply Chain								Rev. 1
		2216245									15-Nov-25
Seq	Area	Potential Failure Mode	Potential Effects of Failure	Severity	Potential Causes of Failure	Occurrence	Preventative Measures	Detection	R.P.N.	Recommended Actions	Responsible
1	Supplier Production	Chemical Composition Failure	Incorrect Mechanical Properties	8	Incorrect alloy additions	4	Require certified chemistry & metallurgical reports for each slab	5	160	Introduce mandatory incoming chemical analysis for all critical heats with hold until pass in spec	Procurement & Supplier Technical Team
2					Inaccurate melting/tapping practises at cast house	4	Enforce supplier qualification with metallurgical audits	5	160	Add supplier corrective action plans for recurring chemistry deviations	Procurement & Supplier Technical Team
					Inadequate cooling rate control	4	Cooling rates and heat treatment requirement in contracts	5	160	Update procurement specs to include max allowable element tolerances	Procurement & Supplier Technical Team
3					Contamination	5	Inbound visual checks and stored	5	200	Establish trending of incoming mech test results and	Port Talbot Technical

							under contamination controlled conditions			improve escalation methods when limits approached	
5			Non Heat Treatable	8	Supplier Shipped wrong grade due to mislabelling/administrative	4	Require slab grade and heat number on all shipping docs	5	160	Implement pre-shipment hold & release for critical grades, reject mismatches on arrival	Port Talbot Technical
					Incorrect product spec ordered	4	Pre shipment verification and management sign offs for critical grade orders	5	160	Provide supplier training on coding which link to PT coding system	Procurement
					Process deviations	5	None	5	200		
6			Unsafe material for automotive industry	8	Inclusion of impurities	5	Automotive limits included in purchase specs and supplier audits	4	160	Enforce supplier approval program specifically for automotive material with routine audits and sample verification trials	Procurement & Supplier Technical Team
					Inadequate degassing during secondary steelmaking	5	Supplier required to provide degassing records	4	160	Introduce contractual right to-audit and immediate containment/remediation procedures for out of spec material	Procurement & Supplier Technical Team
					Supplier quality system not aligned to automotive	4	Further testing performed on high risk heats. Including	3	96	Establish an escalation pathway to halt release of potentially unsafe	Port Talbot Technical

					cleanliness requirements		destructive and non-destructive testing			slabs to production pending further investigations	
7			Hot Shortness	8	Presence of Impurities	4	Require certified chemistry & metallurgical reports for each slab	5	160	Introduce mandatory incoming chemical analysis for all critical heats with hold until pass in spec	Port Talbot Technical
					Non-uniform solidification in slab centre	4	Solidification practises specified	5	160	Work with supplier to revise casting/cooling parameters where recurring hot shortness is observed	Procurement, Supplier & Port Talbot Technical Team
					Inappropriate rolling temperatures	3	Furnace temperatures monitored and controlled via SCADA systems	3	72	Introduce furnace instrumentation alarms for non-conformity and implement corrective actions	Port Talbot Technical & Mill Production team
8			Reduced Ductility	8	Incorrect microstructure from improper cooling method	5	Supplier to provide controlled cooling and microstructure targets per slab	5	200	Improve release procedure by implementing mech held techniques to suspect slabs	Port Talbot Technical
					Excessive nitrogen/hydrogen	5	Hydrogen control measures in place for sensitive grades	5	200	Introduce corrective supplier actions and adjust procurement to suppliers consistently	Procurement & Supplier Technical Team

										meeting the ductility targets	
9			Surface Cracking	7	Surface defects	5	Pre rolling surface inspection performed	4	140	Install optical inspection	Port Talbot Technical & Mill Production team
		Thermal shock from incorrect heating or rapid cooling			5	Supplier provides surface condition certificates	4	140	Introduce eddy-current testing on incoming slabs to detect surface defects early	Port Talbot Technical	
		Inadequate descaling & inspection process			4	Furnace temperature ramp rates are controlled	3	84	Establish a pre rolling repair line for surface conditioning, logging any repairs and feedback to supplier non-conformity	Mill Production Team	
10			Embrittlement	7	Hydrogen pickup	5	Supplier to provide hydrogen control process	5	175	Implement a monitoring program for hydrogen throughout the incoming slabs and track trends	Port Talbot Technical
					Inadequate degassing	4	Supplier to provide degassing records for proof of desired grade	5	140	Quarantine and further test slabs for hydrogen content and hardness before rolling commences	Port Talbot Technical & Mill Production team
11		Metallurgical Defects	Centreline Segregation	8	Inappropriate casting speed	4	Controlled casting speeds optimised for slab section size	4	128	Introduce metallographic cuts from supplier	Procurement & Supplier

								on a frequent basis and hold material pending poor results	Technical Team		
				Excessive slab thickness	4	Supplier required to provide solidification parameters	4	128	Supplier now to provide corrective action plans where segregation is detected	Procurement & Supplier Technical Team	
				Insufficient degassing	5	Supplier to provide degassing records for proof of desired grade	5	200	Implement contractual penalties where non-conformances are repeated	Procurement	
				Incorrect withdrawal rates from caster	4	Supplier required to provide solidification parameters	4	128	Improve collaboration with supplier to optimise caster settings for problematic thickness and document the agreed setpoints in a service level agreement	Procurement & Supplier Technical Team	
12			Internal Cracks	8	Thermal shock from incorrect heating or rapid cooling	4	Correct heating and cooling parameters established and enforced	4	128	Require suppliers to perform ultrasonic testing on slabs prior to shipment and provide certificates	Procurement & Supplier Technical Team
					Mechanical damage during transport	4	Gentle handling procedures in place	5	160	Define yard stacking system with RFID tags to reduce risk of over stacking slabs	Procurement & Mill Production Team

				Hydrogen & Nitrogen assisted cracking from trapped gases	4	Degassing and hydrogen control procedures in place	5	160	Perform thorough root cause analysis for slabs featuring internal cracks, collaborate with supplier technical teams and document corrective actions	Procurement & Supplier Technical Team
13			Porosity	Gas entrapment	4	Supplier to provide degassing records for proof of desired grade	6	192	grades where porosity has historically been present to require ultrasonic/eddy current testing as standard procedure	Procurement, Supplier & Port Talbot Technical Team
				Turbulent melt flow	4	Controlled casting practises with appropriate moulds and pour rates to minimise turbulence	5	160	Supplier to incorporate porosity metrics into certificates and must fall within spec	Procurement & Supplier Technical Team
				Insufficient deoxidation	4	Supplier to provide degassing records for proof of desired grade	6	192	Introduce supplier remediation procedures for recurring porosity issues and include in contract	Procurement & Supplier Technical Team
				Rapid solidification rates trap gas before it escapes	4	Supplier required to provide solidification parameters	5	160	Perform future engineering studies with supplier to optimise casting where porosity is persistent	Procurement & Supplier Technical Team

19		Dimensional Failures	Incorrect Slab dimensions	7	Inaccurate caster settings	4	Supplier provides casting and dimensional control plans for each slab	5	140	Each slab requires mandatory pre shipment acceptance report and dimensional certificate for all slab	Procurement & Supplier Technical Team
					Worn Moulds	4	Supplier to inspect moulds on a frequent basis with date and time recorded	7	196	Improve inbound dimensional inspection at Port Talbot and record results in database	Mill Production Team & Port Talbot Technical
					Thermal shrinkage	4	Correct cooling parameters adhered too	6	168	Develop corrective action reports for out of tolerance dimensions, including financial remedies	Mill Production Team & Port Talbot Technical
					Errors in cutting stations	5	Periodic maintenance and calibration schedules for cutting and sizing equipment at supplier plants	5	175	Continue to track non-conformances in a supplier dashboard and implement more efficient methods to escalate issues to procurement and supplier technical teams	Port Talbot Technical & Mill Production Team
					Inconsistent measuring methods at supplier	4	Dimensional tolerances and measurement methods standardised throughout supplier	6	168		
20			Incorrect Slab Shape	7	Uneven cooling	4	Correct cooling parameters adhered too	6	168	Create a dedicated incoming checking area at Port Talbot storage yard to perform shape measurements and	Mill Production Team

										introduce a photographic documentation system on arrival	
					Mechanical restraints	4	Acceptable flatness tolerances are specified with supplier with mechanical restraint modified to support this	5	140	Implement a quarantine area for slabs with unacceptable shape, when slabs are placed here it will trigger a supplier investigation	Procurement & Mill Production Team
					Poor handling	6	Transport and storage requirements are specified prior to shipment	4	168	Encourage suppliers to adjust the casting parameters if consistent misshaped slabs occurred	Procurement & Supplier Technical Team
					Inadequate control of section thickness for intended mills	4	Routine inspections and maintenance of equipment to ensure uniform cooling	4	112	Incorporate slab shape metrics into supplier scorecard, with non-conformances results in remedial actions	Procurement
26					Contamination	Surface Contamination	6	Contact with corrosive substances	5	Slabs covered with breathable coverings for shipment on ships	3

					Poor cleaning prior to dispatch	6	Supplier cleaning SWPs reviewed and deemed acceptable	3	108	Build contract clauses where suppliers are to remediate or replace slabs with unacceptable contamination	Procurement & Supplier Technical Team
					Stored in unprotected yards	6	Designated storage zones at Port Talbot	3	108	Evaluate sustainable cleaning options and solvent recycling to reduce environmental impact whilst maintaining surface quality	Port Talbot Technical & Mill Production Team
27					Poor coverings allowing moisture	5	Coverings of slabs are monitored closely and replaced with new when unsuitable	3	90	Potential to install a small capacity degrease facility in Port Talbot for rapid remediation of minor contamination on arrival before stored in stock yards	
#REF!		Processing	Inadequate process documentation	6	Reliance on paper records	5	Digital document control system in use	3	90	Improve digital system to a live database which can be updated and viewed by both suppliers and customer	Port Talbot Technical
					Non-standard document templates	5	Standard templates used	4	120	Introduce a 2 step verification process between supplier	Port Talbot Technical

									pre-check and port talbot verification				
					Human error	6	Mandatory training provided on documentation standards	4	144	Schedule periodic audits of supplier paperwork and internal digital systems	Procurement & Port Talbot Technical		
					Insufficient training on importance of process documentation	4	Mandatory training provided on documentation standards	4	96	Implement tracking metrics of document rejection rates in a monthly dashboard and set improvement targets	Port Talbot Technical & Mill Production team		
31					Inconsistent Quality control	7	Supplier cost cutting exercises	4	Supplier quality control plans to be submitted and approved before shipment	5	140	Contact additional accredited third party providers to perform audits	Port Talbot Technical
							Lack of standardisation	5	Routine inspections	5	175	Improve root cause analysis on all QC failures and documentation of them	Port Talbot Technical
							Staff Shortages	5	Competency scheme in place to cover shortfall of staff	5	175	Require supplier to attach valid certificate on calibration on every shipment, any shipment with no evidence can be rejected or financially less	Procurement & Supplier Technical Team
							Expired calibration certificates	5	Mandatory calibration schedules and traceable calibration certificates for all equipment	4	140		

34		Packaging & Handling	Mechanical Damage during loading/unloading	7	Poor Lifting aids	5	All lifting gear approved and adhere to lifting standards	5	175	Suppliers need to submit evidence of lifting equipment certification and maintain a register of approved lifting vendors to periodically audit their compliance	Procurement & Supplier Technical Team
37					Stacking errors	5	Standard stacking patterns arranged with stack height limits set	6	210	Improve floor plan which matches slab ID's to designated storage space. Any incorrect stacking incidents need to be recorded and escalated if repeated	Mill production teams
40					Improper securing of slabs	5	Photographic evidence of each slab securely fastened to avoid damage	6	210	Maintain contractual liability clauses and engage in periodic joint supplier and carrier workshops to align on securement standards and share lessons learned from incidents	Procurement & Supplier Technical Team
		Human Factors	Operator Errors	7	Lack of Motivation	5	Regular employee engagement surveys	6	210	Encourage supplier to establish further reward and recognition programs that	Procurement & Supplier Technical Team

									celebrate productivity		
					Pressure from management	4	Realistic lead times and standards set with a safety first culture firmly in place	6	168	Encourage supplier to introduce regular Service level agreement meetings between management and operations teams to ensure targets are aligned at all times	Procurement & Supplier Technical Team
					Difficult working conditions	2	Occupational health checks conducted periodically	4	140	Encourage supplier to upgrade welfare and break facilities in an attempt to improve employee satisfaction which will therefore improve productivity	Procurement & Supplier Technical Team
45		Supplier Insolvency	Shortage of Material	7	Supply chain disruptions	5	A buffer stock of imported slab held at Port Talbot	4	140	Implement real time supply chain visibility tools for monitoring of shipment	Procurement, Supplier & Port Talbot Technical Team
					Raw material scarcity	2	Relationships with multiple global suppliers	5	70	Continue to develop relationships with new suppliers to reduce dependency on long distance suppliers	Procurement

					Unexpected demand	2	None	6	84	Increase buffer stock during traditional high demand periods	Procurement
47					Lack of Environmental compliance	4	Sustainability audits carried out periodically	6	216	Implement sustainability scorecards to track performance against environmental and social concerns	Procurement
					High carbon process	6	Environmental governance criteria adhered to when assessing suppliers	6	324	Introduce incentives or preferred supplier status for those demonstrating continuous sustainability improvements	Procurement & Supplier Technical Team
		Supplier sustainability concerns	Financial Burden	9	Poor labour/Ethical practises	3	Training and guidance provided for supplier to meet sustainability expectations	5	135	End contracts/partnerships with non-compliant suppliers and continue with suppliers that believe in low-carbon and greener steel	Procurement
					Poor Pollution control	5	Carbon footprint is monitored	6	270	Collaborate with logistics partners to decarbonise transportation routes and packing process	Procurement & Logistic Teams

					Lack of transparency	3	Strict supplier vetting and due diligence procedures in place	4	108	Develop a global traceability system to track raw material sourcing down to tier 2 and tier 3 suppliers	Procurement
					Weak labour enforcement	3	Third party audits on regular basis	4	108	Continue to engage in stakeholder communication plans to rebuild trust and protect brand reputation in case of any violation	Stakeholders
51		Child labour	Legal Financial penalties & Reputational Risks	9	Cost cutting exercises	4	Clauses included in supplier contracts for failure to comply with Tata Steel standards	4	144	Work collaboratively with supplier to improve local labour standards through education and welfare programs	Procurement & Supplier
					Lack of due diligence	2	Strict supplier vetting and due diligence procedures in place	4	72	Ensure all suppliers are aware of Tata Steel zero tolerance policy on child labour and communicate publicly and to customers	Procurement & Supplier
#REF!	Logistics	Incorrect Documentation	Custom clearance delays	7	Administrative errors in documentation	5	Digital document control system in use	4	140	Improve the digital system to automatically flag incomplete or inconsistent data.	Procurement & Port Talbot Technical

									Add required fields for missing values	
									Continue with regular audits of customs documentation to ensure compliance	Procurement & Customs
									Establish more efficient direct communication channels between suppliers and port talbot logistics teams	Procurement, Supplier & Logistics
#REF!									Assign dedicated import documentation coordinators throughout the business	Port Talbot HR
									Improve the shared digital portal	Port Talbot Technical
									Chase up a drop in KPI's in supplier contracts	Procurement & Supplier
#REF!									Introduce live shipping tracking dashboards linking customs status with plant planning teams.	Port Talbot Technical
									Build a document readiness checklist used jointly by	Procurement, Supplier & Logistics

				document related issues				supplier and port talbot logistics		
#REF!				Improper certification	4	Up to date compliance training for all personnel involved in import documentation	5	160	Deploy a compliance management system to track documentation accuracy and any changes to regulations	Port Talbot Compliance Department
			8	Outdated understanding of evolving UK import/export regulations	3	Up to date compliance training for all personnel involved in import documentation	5	120	Partner with customs consultants to review and approve all new import routes and suppliers	Procurement
58				Port congestion	4	Close coordination with shipping agents is maintained	6	168	Investigate opportunities for long term contracts with preferred shipping partners to secure port access	Procurement
				Adverse weather	4	None	7	196	Develop contingency plans for adverse weather, potential for quick supply from local suppliers	Procurement
				Insufficient vessel scheduling	4	Booking slots, with alternative ports have been established	6	168	Review the demurrage and port congestion clauses in the	Procurement

								supplier contracts to ensure that they are appropriate		
63				Mechanical break downs	4	Contingency parts, equipment	7	196	Continue to attend regular meetings with logistics partner to access delays and performance related issues	Procurement & Logistic Teams
#REF!			Increased Demurrage costs	Stikes or industrial action	2	Global and local port activity is monitored closely	8	128	Implement a port performance review framework to track unloading efficiency	Port Talbot Technical Team
				Late arrival of previous cargo	5	None	7	280	Review demurrage insurances in place to minimise cost outlay	Procurement
				delayed unloading due to insufficient manpower or equipment availability	4	None	7	224	Establish a cross functional response team to act early on delay warnings	Port Talbot Technical Team
			Equipment breakdowns	Ageing port infrastructure	4	Regular maintenance audits performed with port auditors	7	196	Maintain performance based contracts with shipping lines to incentivise reliability	Procurement
				Mechanical failure on vessels	4	Supplier with strong reliability records are prioritised	7	196	Collaborate with backup port options to cover breakdowns	Procurement

#REF!	Adverse Weather	Delivery Delays, weeks?	7	Prolonged storms	4	Buffer stock at PT to supply downstream operations	8	224	Negotiate supplier and carrier contracts with clear contingency provisions for adverse weather	Procurement, Supplier & Logistics
				Extreme cold	4	Real time tracking of vessels	8	224	Establish a approved alternative port log and rapid rerouting procedure to be implemented when forecasts indicate high risk weather	Procurement
				Reduced vessel speed due to precautionary routing due to adverse weather	4		8	224		
#REF!		Cargo movement could cause damage/ lost cargo	9	Insufficient sea fastenings	4	Suppliers required to provide marine insurance certificates to cover any cargo lost at sea	6	216	Collaborate with third party marine surveys at load port which can refuse shipment without verified securement	Procurement & Third Party Marine Surveyors
				Suboptimal stowage location, on top deck instead of below	4	Pre shipment photographic evidence of secured slabs provided	5	180	Build a lessons learned log of securing failures to avoid mistakes happening again	Port Talbot Technical Team
67	Improper Securing of Slabs	Slab collide during transport causing damage	8	Insufficient sea fastenings	4	Pre shipment photographic evidence of secured slabs provided	6	192	Collaborate with third party marine surveys at load port which can refuse shipment without verified securement	Procurement & Third Party Marine Surveyors
				Worn/defective equipment	4	Regular maintenance audits performed with port auditors	6	192		
				Inexperienced operators	5	Mandatory training provided	5	200	Maintain performance based	Procurement

			failure to follow standard loading procedures	5	Mandatory training provided	5	200	contracts with shipping lines to incentivise reliability	
70			Excessive slab movement	4	Impact protection and rubber mats used to limit slab movement, along with correctly fastened material	6	168	Integrate feedback from ship captain and crew into future securing plan improvements to further improve process	Procurement & Logistic Teams
			Failure to use protective barriers between slabs and vessel structure	4	The securing points on the vessel are standardised and engineered for slab mass and distribution	6	168		
#REF!			Slabs not correctly restrained	4	Pre shipment photographic evidence of secured slabs provided	6	216	Enforce a permit to work system for crew to enter slab hold areas, with all permits available to Tata Steel and customers on request	Procurement & Logistic Teams
			Inadequate securing equipment	4	All personnel are trained in hazard identification and safe loading practise	6	216	Supplier and carriers required to share any accidents or near misses with Tata Steel logistics team	Procurement, Supplier & Logistics
			Crew entering cargo areas during heavy motion	4	Safety exclusion zones implemented on vessels	7	252	Conduct joint safety reviews between supplier, carrier and Tata Steel logistics team	Procurement, Supplier & Logistics Team

75		Temperature & Moisture exposure	Corrosion & contamination of slabs	6	Open deck storage	5	Specified below-deck storage for critical slabs	4	120	Work with vessel owners to implement moisture sensors during transport in the future, review costs and benefits	Procurement, Vessel Owners & Logistics
					Storage under tarpaulin which trap moisture	5	Use of breathable coverings	4	120	Implement contractual penalties where slabs suffering corrosion on arrival which is deemed unacceptable	Procurement & Mill Production Team
					Loading in wet conditions	5	None	6	180		
#REF!			Rework & surface cleaning at PT, potential for further delays	7	Arrival of slabs with surface rust, oil which will require meticulous cleaning	5	Maximum acceptable surface condition on procurement documents and supplier to provide evidence pre dispatch	5	175	Capture costs for rework events and communicate this with supplier to hopefully find remedy for inconvenience	Procurement, Port Talbot Technical Team & Supplier
					Lack of on-site degreasers or equipment to handle volume spikes	4	Port talbot has scalable capacity and maintains consumable stocks	5	140	Future work is to develop a in depth rolling evaluation of wash bay capacity versus forecast arrivals and increase temporary capacity when thresholds are exceeded	Port Talbot Technical
99		Customs Delays	Vessel delay at port	7	Incorrect documentation submitted	4	Pre-clear customs before vessel arrival	5	140	Monitor tariff and regulations closely and work with	Procurement & Customs

104		Increased Demurrage costs	8	Random Inspections	4	Spare supply of slab at PT should issues arise	6	192	custom control to form partnerships	
106	Inland transportation failures	Slab damage	7	Poor road conditions	4	Certified heavy-haul carriers are used with proven experience carrying slabs and heavy duty	7	196	Review agreements with rail industry to explore the options around increasing number of carriages delivered each week	Procurement, Rail Network & Logistics
				Poorly secured loads	4	Haulage companies to provide photographic evidence of properly secured slabs to ensure the safety of goods and drivers on road/rail	6	168	Establish a carrier qualification programme (insurance, equipment spec, maintenance records, references) and maintain an approved carrier list.	Procurement
				Weather related issues (Heavy Rain, snow/ice)	4	Shipments are scheduled to avoid extreme weather that could degrade road conditions	8	224	A pre-dispatch sign-off by a competent person is required and a photo log attached to the shipment record. Any loads without verification can be refused	Procurement, Supplier & Logistics
109		Potential safety incident	9	Fatigue in personnel	5	Carrier to comply with statutory hours	7	315	Look to enforce with the carrier companies, a 2	Procurement & Logistic Teams

						of service as per agreement			driver rule for long haul or high risk deliveries, where single driver fatigue poses a material safety risk		
					Poor scheduling that forces night driving or in bad weather	4	Fatigue Risk Management Systems (FRMS) included in carrier contracts these are for mandatory rest periods, shift limits and recovery time.	5	180	Run joint safety workshops with carriers focused on fatigue mitigation, rest planning and emergency procedures. Capture lessons learned after any incident.	Procurement & Logistic Teams
					Inadequate driver training	4	Deliveries planned with realistic ETAs and buffer times to remove incentive for speeding or extended hours.	5	180	Conduct periodic roadside or depot-based checks of driver fitness and escalate any fatigue concern	Procurement & Third Party Auditors
#REF!		Insurance	Losses non recoverable in case of damage or loss at sea	8	Policy lapses	2	Suppliers required to provide marine insurance certificates to cover any cargo lost at sea	6	96	Routinely review terms of insurances in place and identify responsibilities clearly in the contracts	Procurement
#REF!					Misunderstanding of terms	4	Automated alerts for policy renewal or expiry dates	5	160	Implement a shared insurance verification register that records policy numbers, expiry	Procurement

									dates, and insured cargo values.		
#REF!			Legal disputes between Tata & Supplier	8	Ambiguous insurance responsibilities in contracts leading to liability disputes	3	Clearly defined liability and claim handling responsibilities within the supply agreement	6	144	Develop a dispute resolution framework which is easy to follow specifying mediation and arbitration procedures	Procurement
		Different legal jurisdictions between Tata Steel and international supplier			3	Clear jurisdiction clauses and dispute resolutions in all contracts	6	144	Assign a dedicated insurance and legal contract at Tata Steel Port Talbot to manage all marine insurance claims	Port Talbot HR	
		Discrepancy between party filing the claim and the party insured			3	Joint insurance reviews between Tata and Suppliers before initiating new contracts	5	120	Continue to engage with external insurance advisors periodically to validate compliance and reduce risk of future disputes	Procurement & External Insurance advisors	
#REF!		Port Strikes & Political Unrest	Delays in loading/unloading	7	National strikes	2	Diverse export ports and shipping lines	7	98	Review contracts with suppliers and customers and look to include financial clauses into contracts to offset any fines if issues such as strikes arose	Procurement, Suppliers & Customer

#REF!			Vessel Diversions	7	Port authority disputes	4	Maintain a safety buffer of slab at PT which could supply downstream operations if the desired grade was available	7	196	Establish alternative port arrangements in nearby regions and engage in government and logistics networks to receive early notifications of disputes.	Procurement, Government Officials, Logistics team
#REF!			Extended lead times	7	Trade restrictions	4	Partnerships with customers, ability to engage in positive conversations and identify solutions should these issues arise	7	196	Develop trade compliance monitoring strategy to reduce reliance on single trade routes.	Procurement
		World Events	Lack of production	10	War, Covid, Brexit	2	None. Potential to stay up to date with world news in the hope of gaining market knowledge	8	160	Implement a wider supplier base which covers different continents, this would increase the chance of a safer supply chain	Procurement & Suppliers
#REF!		Health, Safety or Environmental Incident during logistics	Injury to crew members	9	Unsafe handling	4	Logistics partners adhere to the HSE standards	7	252	Perform regular and non-regular audits of the loading ports to ensure adherence to safety rules	Procurement, Third Party Auditors & Port personnel
					Inadequate PPE	4	Logistics partners adhere to the HSE standards	6	216	Environmental risk assessments required before each shipment.	Procurement & Suppliers

					Poor emergency response procedures	2	Logistics partners adhere to the HSE standards	6	108	Develop and test emergency response and contingency plans with logistics partners. Conduct periodic drills and assign clear roles and communication lines for response teams to reduce response time and downtime.	Procurement & Logistic Teams
136			Environmental fines	9	Logistic partners failing to follow environmental regulations	3	Logistic partners also require adherence to Tata Steel Health & Safety measure	7	189	Establish a corrective action reporting process for any partner found in breach	Port Talbot Technical
	Storage of Slabs	Over stacking in stockyard	Stack collapse causing major safety incidents or material damage	9	Inadequate ground bearing capacity assessment	2	Strict stacking procedures (Max height, alignment and base conditions)	7	126	Introduce an electronic yard management control that prohibits stacking above safe heights, and can also record who authorised each lift for traceability	Mill production teams
					Failure to follow stacking pattern procedures	4	Safety barriers and exclusion zones around stacked areas	6	216	Deploy routine spot audits of stacking operations with corrective coaching where deviations are found. Repeated	Mill Production teams, Port Talbot compliance teams

								breaches of compliance need to be escalated and recorded in performance dashboards	
			Waterlogging causing softening of the yard, reducing bearing capacity	4	Yard drainage installed and surface hardening concrete is used	5	180	Schedule seasonal and post extreme weather inspections of ground condition and base integrity, temporarily reduce stack heights or relocate stacks if ground condition has deteriorated	Mill Production teams, Port Talbot compliance teams
			Time pressure leading to unsafe stacking practises	4	Mandatory training and certification for yard stacking crews, with team leader approving sign off on any deviation from SWP.	5	180	Invest in an annual independent safety audit which includes structural review and publish any remediation plan with deadlines for any identified issues	Procurement & Third Party Auditors
		Deformation of lower slabs affecting rolling flatness and yield	Excessive stack height	4	Strict stacking procedures (Max height, alignment and base conditions)	6	168	Implement a measurement process for sample flatness checks (straightness/camber) on arrival for slabs from high-risk stacks and hold suspect slabs for reconditioning	Port Talbot Technical & Mill Production team
			Prolonged stacking of slabs	5	Slabs rolled based on deadline date and priority	6	210		

				Stacking incompatible slab geometries without readily available load distribution measures	5	Yard block is designed to avoid mixed stacking of slab mismatches	6	210	Quantify flatness non-conformances and capture data to find root cause	Port Talbot Technical
		Surface corrosion	6	Prolonged exposure to salt-laden conditions or rain	5	High performance, breathable coverings are used if slabs are stored outside	6	180	Enhance yard storage system to ensure slabs are stored under cover, improve organisation so that when slabs are due to be rolled they are moved to space easiest for manoeuvre	Port Talbot Technical & Mill Production team
				Inadequate slab coverings	5		5	150		
				Failure to apply temporary corrosion inhibitors	4	Suppliers apply approved temporary corrosion inhibitors and provide photographic evidence	6	144		
		Higher mill cleaning requirements	6	Arrival of slabs with salt deposits or oil/grease residues requiring additional mechanical or chemical cleaning	5	Clearly defined surface condition required in line with acceptance criteria	5	150	Site configuration could be improved to route inbound slabs first to inspection and wash stations prior to furnace entry	Port Talbot Technical & Mill Production team
				Insufficient wash/cleaning capacity at Port talbot	4	Dedicated wash/degrease bays at Port Talbot with scalable capacity	5	120	Integrate surface condition checks into the yard management system and train yard staff on rapid triage to prioritise cleaning	Port Talbot Technical & Mill Production team
				Lack of agreed acceptance criteria leading to variable cleaning decisions on arrival	5	Clearly defined surface condition required in line with acceptance criteria	6	180		
		Exposure to weather	6	Arrival of slabs with salt deposits or oil/grease residues requiring additional mechanical or chemical cleaning	5	Clearly defined surface condition required in line with acceptance criteria	5	150	Site configuration could be improved to route inbound slabs first to inspection and wash stations prior to furnace entry	Port Talbot Technical & Mill Production team
				Insufficient wash/cleaning capacity at Port talbot	4	Dedicated wash/degrease bays at Port Talbot with scalable capacity	5	120	Integrate surface condition checks into the yard management system and train yard staff on rapid triage to prioritise cleaning	Port Talbot Technical & Mill Production team
				Lack of agreed acceptance criteria leading to variable cleaning decisions on arrival	5	Clearly defined surface condition required in line with acceptance criteria	6	180		

	Loss of identification	Traceability loss	7	Poor tag adhesion	5	Use of industrial grade, weather resistant paint for labelling of slabs to help aid clear identification	7	245	Look to swap to a barcode/RFID system which can be linked to a digital database	Procurement, Technical teams, external contractors
				Human error during yard entry	5	Staff are trained and competence checks are confirmed on a quarterly basis	7	245	Look to swap to a barcode/RFID system which can be linked to a digital database	Procurement, Technical teams, external contractors
				Corrosion or dirt obscuring markings	5	Slabs labelled with heat number multiple times on each side of slab to maximise chances of visible id	6	210	Look to swap to a barcode/RFID system which can be linked to a digital database	Procurement, Technical teams, external contractors
	Mechanical Damage during internal transport (Cranes etc)	Surface impact damage from dropped slabs	7	Sudden vehicle braking	5	Vehicle speed limit with brake speed installed	6	210	Integrate telematics to monitor harsh braking /acceleration events and use data to coach and train drivers/operators	Mill production team
				Inadequate load restraint	4	Standardised securing procedures adhered to	5	140	Track impact damage incidents in a defect register and corrective actions are required from responsible teams	Port talbot technical team
				Slabs stacked without anti slip material	4	Anti slip mats are in use and inspected before performing as per procedure	6	168		
		Potential injury to personnel	10	Poor visibility	4	Adequate lighting systems in place	5	200	Improve on disciplinary and positive	Local level management site wide

								reinforcement policies tied to adherence to exclusion zones and safety permits	
			Inexperienced operators	4	All personnel are trained in hazard identification and safe loading practise	5	200	Routine behavioural observations and audits across all shifts to ensure the compliance from internal personnel	Local level management site wide
			Lack of communication between crane operators and ground crew (No radios/signalling)	4	Standardised protocols are used included personal radios for clear communications	5	200	Conduct future simulated emergency rescue drills for slab handling incidents and update rescue procedures accordingly	Local level management site wide
		Downtime for investigation & clean-up	Accidents	4	Readily accessible spill kits, lifting recovery equipment and trained response teams at yard locations	6	216	Create a defined incident response agreement which indicates the time to secure, time to clean and time to resume and test this procedure on a quarterly basis	Local level management site wide
			Lack of onsite resource to respond quickly	4	Trained staff on a concise incident response plan (Contain, Isolate, Report) that minimises production impact	5	180	Implement a streamlined investigation protocol so production is minimised	Local level management site wide

				Poor incident workflows causing delays in authorisation to resume operations	4	Standardised workflows with required fields to ensure documentation is correctly completed	6	216	Collect and analyse downtime and cleanup costs, use the data to prioritise preventive investments	Port Talbot technical team
	Fire Damage	Surface damage to slabs	8	Hot work such as welding, grinding carried out to close to slabs	4	Hot work zones are segregated from slabs with physical barriers in place	6	192	Review the standard for hot work permit process and ensure it remains adequate. Continue to record and investigate any spark related near misses	Port talbot technical team & Compliance department
		Metallurgical changes	7	Storage of combustible materials near slabs	4	Robust 5s standards are kept on site, with specified areas and waste bins which are separated from slabs	5	140	Implement an environment incident response plan that includes air quality monitoring	Port Talbot technical team & Emergency services
		Environmental emissions	7	Fires or hot work near slab producing smoke which trigger community/regulatory complaints	4	Hot work zones are segregated from slabs with physical barriers in place	5	140	Engage in local environment authority meetings to proactively agree response thresholds	Port Talbot technical team & Emergency services
	Contamination from ground (Oil, Debris, etc)	Contamination of reheating furnaces refractories	7	Dirt, Oil, Debris transferred from unclean yard surfaces onto slab which will then burn off in furnace	5	Scheduled yard cleaning programs	5	175	Future project is to capture furnace refractory maintenance costs which are believed to be from contaminated slabs	Port talbot technical teams

								and look at ways to improve the process		
				Infrequent yard cleaning allowing build up of contaminants	5	No oily equipment or materials to be stored near the slabs is the standard which is set	5	175	Install an inspection zone where inbound slabs are visually checked and cleaned before furnace feed to minimise risk of contamination	Mill production team
			Defects in rolled product surface	8	Hydraulic fluid leaks	5	Drip trays installed under parked hydraulic equipment to monitor for any leaks	5	200	Improve inspection procedures on all equipment relating to lifting of slabs
	Poor maintenance of lifting gear or vehicle beds that transfer oils during handling procedures	4			Routine maintenance is performed on lifting equipment	5	160			
	Unauthorised Access	Damaged materials	8	Inadequate perimeter fencing	4	Fencing installed around site, with controlled gated access into high risk areas	7	224	Upgrade site wide security system with surveillance team to monitor CCTV	Security & IT Department
				Security patrols not frequent enough	4	Site security operate 24/7 with regular patrols	7	224	Introduce a motion detection system which will notify security staff	Security & IT Department
				Lack of deterrents	4	CCTV system and alarms in place to warn off intruders	7	224	Improve lighting and visibility across yard areas, aiming	Security & IT Department

								for blind spots near slabs	
	Damaged identification tags	8	Vandalism	2	Site security operate 24/7 with regular patrols	6	96	Upgrade entry systems to include controlled ID verification linked to employee clock in card	Security & IT Department
			Inadequate tag protection making them vulnerable to weather or tampering	4	Slabs labelled with heat number multiple times on each side of slab	6	192	Explore use of RFID/barcode tagging which is integrated into a yard management system	Security & IT Department
	Safety risks	9	Unauthorised personnel entering restricted zones leading to injury	4	Manual sign in to restricted zones is required on site	6	216	Upgrade entry systems to include controlled ID verification linked to employee clock in card	Security & IT Department
			Poor visibility in dark conditions	4	Adequate lighting systems in place	5	180	Future plan is to look at upgrading lighting system to LED lighting so that it is a higher intensity	Security & IT Department
	Reputational risks	9	Negative publicity	4	None	8	288	Introduce a robust visitor and contractor registration process which is documented on a digital platform	Security & IT Department
Slow response to security incidents due to short staff			4	Security and large parts of site work on a 24/7 basis ensuring	6	216	Roll out regular training and courses to staff to	Local level management site wide	

					areas of activity are manned			encourage them to report any suspicious activities	
Equipment breakdowns	Delays in rolling operations	7	Lack of preventative maintenance	6	Preventative maintenance carried out on a routine basis	4	168	Replace obsolete equipment through CAPEX investment plan	Local level management site wide
			Ageing /outdated mechanical or electrical systems	6	Digital management is used to track asset health (SAP)	4	168	Implement a asset criticality assessment to prioritise maintenance resources effectively	Local level management site wide
			Insufficient operator knowledge	5	Operators trained to perform inspections and report abnormalities promptly	5	175	Establish cross functional review meetings between maintenance and production to monitor downtime trends	Local level management site wide
			Absence of predictive tools	5	Predictive maintenance and condition monitoring implemented to avoid sudden critical failures	5	175	Continue to monitor predictive maintenance tool to ensure its validity	Port talbot technical teams
	Increased risk of unsafe manual intervention	8	Equipment downtime forcing manual handling	5	Strong partnerships with maintenance contractors to help aid mechanical/electrical breakdowns	5	200	Conduct regular audits of contractors/maintenance staff to ensure they are working in a safe manner	Port Talbot Compliance Department

				Insufficient automation	5	SWP's maintained for any manual interventions needed	6	240	Ensure the SWP's remain up to date and valid for undergoing any tasks	Local level management site wide
				Inadequate supervision during reactive maintenance	5	Shift Manager/Team Leader to oversee reactive maintenance with regular Point of work risk assessment (POWRA) carried out	5	200	Improvement needed for reviewing POWRA and documenting these better	Local level management site wide
	Internal communication failure	Wrong slabs delivered to furnace	7	Reliance on manual communication	5	Daily coordination meetings between logistics, Quality and mill operations to confirm slab priority sequence	6	210	Use visual management tools to display real time loading information	Local level management site wide
				Lack of integration between yard inventory systems and production team	5	Standardised communication protocols	5	175	Integrate a digital yard management system with a barcode/Rfid scanning at each transfer point to ensure correct slab identification	Port talbot technical team
	Health & Safety	Injury/Fatality	10	Poor segregation from operations	5	Designated walkways and vehicle routes with physical barriers in place	6	300	Potential for a redesign of the high risk areas, look to implement personal code for authorised staff	Local level management site wide
				Complacency	5	Daily toolbox talks, near misses reporting and red stripes to ensure personnel stay alert to dangers	6	300	Monitor compliance through CCTV and escalate repeated breaches	Local level management site wide

				Lack of PPE	5	Adequate PPE inventory stocked with staff trained on mandatory PPE standard	5	250	Team leaders/Shift managers need to drive compliance for PPE and challenge staff not adhering to standard	Local level management site wide
				Night shift operations	4	No lone working rule. Lighting audits conducted on a weekly basis to ensure the areas of operations are well lit	6	240	Future plan is to look at upgrading lighting system to LED lighting so that it is a higher intensity	Security & IT Department
		HSE Investigations	10	Financial Penalties	2	Full training, maintenance, permit to work and risk assessments available on request	8	160	Establish a investigation procedure with trained internal investigators and legal support	Port Talbot Compliance Department
				Reputational Damage	2	None	8	160	Introduce running scenario based exercises with HSE and legal teams to improve response readiness	Port Talbot Compliance Department
		Shutdown for safety inspection	10	Unplanned stoppage	3	Predictive maintenance and condition monitoring implemented to avoid sudden critical failures	7	210	Prepare a business continuity plan that includes safe temporary measures and rapid remediation options to minimise downtimes	Port Talbot Compliance Department, Mill production team, Port Talbot technical

				Lost Production	3	A safety database is used and reviewed on a daily basis with any concerns raised in morning meetings	7	210	Pre agree with regulators on inspection protocols and provide timely evidence of corrective actions to avoid protracted shutdowns	Port Talbot Compliance Department
Mill operations	Internal Defects	Serious quality defects	8	Poor practices at supplier site	4	None. Although supplier provide certificate for all slab specifications	7	224	Implement ultrasonic testing on all slabs pre-rolling	Port talbot technical team
		Rejection during ultrasonic inspection stage	8	Trapped gases, improper heat treatment	4		7	224	More stringent certification from supplier	Procurement & Supplier
	Roller Damage	Higher maintenance costs	8	Inclusion of tramp elements in slab	5	Tramp elements are stated by supplier certification, and checked by internal process	6	240	Introduce a roll wear monitoring system which can detect any wear on the rollers prior to failure	Port talbot technical teams
				Inadequate upstream cleaning system	4	Inspection of slabs upon completion of cleaning to ensure they are suitable for next stage	6	192		
	Poor shape	Reduced Yield	7	Non uniform thickness	5	Slabs sorted and grouped prior to rolling operations, high risks slabs are marked and communicated in regular meetings to explore options	5	175	Yield losses can be captured by slab ID and feed information into supplier corrective action reports	Port talbot technical team

				Variable lubrication across slab surface	5	Consistent lubrication protocols are followed	6	210	Install automatic roll bending system to avoid repeated uneven deformation	Mill Production Team & Port Talbot Technical
				Thermal gradients in the slab at entry produce uneven strain	4	Uniform furnace soak times and slab surface temperature monitored throughout the process	6	168	Run trial phases on any new material from new suppliers, this will ensure you achieve correct parameters when it comes to real material	Port talbot technical, Mill production team
		Customer complaints	8	Cold spots in furnace due to inaccurate zone control	5	Furnace zone controls are calibrated and validated on a routine basis	6	240	Integrate furnace temperature feedback into mill setpoint selection so rolling parameters adapt to actual slab temperature. Enhanced automation	Port talbot technical, Mill production team and IT Services
				Slow transfer times from furnace to mill allowing temperature drop in parts of slab	5	Maximum transfer time windows are defined with expected standards adhered too	6	240	Continue with root cause analysis for each complaint, but improve process by correlating with furnace logs to identify systemic issues, and prioritising corrective maintenance	Port Talbot technical team

	Rework/Scrap	8	Incorrect mill parameters	5	Operators are trained on standardised procedure	5	200	Introduce a pre-rolling system, which models the imported slab travelling through the mill and what the effects will be on specific slab grades at set parameters	Port talbot technical team, mill production team & IT Services
			Insufficient operator knowledge	5		5	200		
			Lack of decision support	5	Slabs which are require non standard practise are highlighted in regular meetings	6	240		
	Data Capture	8	Mismatched ID's	5	Slab ID's follow a standardised coding system which is linked to Port Talbot internal system	6	240	Deploy an automated traceability system mapping the imported slab ID's to Port Talbot internal codes from dispatch through to rolling	Port Talbot Technical, Mill Production team & IT Services
			Separate IT systems between suppliers, logistics and production. (Not shared or live data)	4	Internal system at port talbot is a shared service with regular meetings to raise any issues	6	192	Develop a traceability dashboard displaying live material status and movement history, moving away from manual tasks	Port Talbot Technical, Mill Production team & IT Services
		7	Test data is captured manually and stored in local departments not available to all departments	6	Test results are normally stored on internal database or emailed to internal customer upon completion	5	210	Introduce a digital quality data system that enables downstream operations to gain insights at a real time tracker	Port Talbot Technical, IT Services

			Tests results missing on slab	5	All reporting system include required fields not allowing completion until filed correctly	5	175	Create automated alerts for deviations from specification to enable rapid intervention	Port Talbot Technical, IT Services
	Reheat Furnace Queue delays	Furnace inefficiencies	Incoming batches contain slabs of differing chemistries or thickness that require different parameters	5	Slabs are pre sorted and segregated by reported chemistry and thickness	5	175	Define a standard reheat parameter process which related to specific grades and slab families, such as chemistry, thickness and supplier history	Port Talbot technical
			Manual scheduling that mixes incompatible slabs to meet throughput targets	5	Regular meetings between scheduling and mill operations take place to achieve the most efficient route to roll slabs	5	175	Implement further tracking into furnace efficiency metrics by batch type and adjust scheduling parameters to reduce number of changeovers	Port talbot technical, Mill production team
	Awaiting lab results	Delay of rolling imported slab	Lab results do not match supplier certification	5	Lab follows ISO standards and SWP's with up to date calibration records	5	175	Implement a hold and release policy, slab does not feed to furnace until inbound verification is complete	Port talbot technical
			Laboratory error, calibration drift on analyser	5	Lab equipment maintained on a frequent basis, with all calibration records	5	175	Introduce a expedited testing protocol, analyse the chemistry of incoming slab via	Port talbot technical, mill production team

3.3 Severity

Severity is defined as the potential impact of a failure mode on operational performance or customer outcomes. In this analysis, high-severity failures are characterised by substantial disruptions to the supply of steel slabs, which may interrupt production at Port Talbot or negatively affect downstream customers. As shown in table 4, examples such as supplier transport disruptions have the potential to cause significant operational downtime, financial losses, and reputational damage. Severity ratings are allocated on a scale from 1 to 10, with higher values indicating more serious implications for supply continuity, cost efficiency, or product quality, this is shown below in Table 2.

Process General Evaluation Criteria Severity (S)		
S	Effect	Impact to Supply Chain
10	High	The disruption causes a full shutdown of a critical function or the entire supply chain, leading to major financial loss, reputational damage, regulatory penalties, and possible risks to worker health and safety.
9		
8	Moderately high	Entire or partial production may need to be scrapped, with risks of regulatory non-compliance or ongoing worker safety issues. These failures disrupt normal operations, slow throughput, and require extra labour. The resulting delays can significantly affect key business functions, cause major financial loss, reduce customer satisfaction, and attract negative attention.
7		
6	Moderately Low	All or part of the production may need offline or in-station rework before processing. The disruption causes moderate performance issues or delays, leads to manageable financial loss, inconvenience for customers, and requires effort to put temporary fixes in place.
5		
4		
3	Low	The disruption is small, causing only slight operational inconvenience and minimal financial impact, with no effect on safety, compliance, or customer satisfaction.
2		
1	Very Low	The failure is barely noticeable, has no meaningful impact on safety or performance, and can be easily corrected without affecting customers or disrupting operations.

Table 2 - Severity Matrix for the FMEA

3.4 Occurrence

Occurrence is defined as the likelihood of a failure mode arising within the supply chain. In the context of slab imports, typical risks include port congestion and delays in customs clearance, this is referenced in table 4. Each potential failure is assessed with reference to historical performance data, global logistics trends, and indicators of supplier reliability. Similarly to severity, occurrence is also allocated on a scale from 1 to 10, with higher values indicating greater occurrence, this is shown in table 3.

Occurrence Potential (O) for the Process		
	Time Based Failure Cause Prediction	Prevention Controls
10	Every time	No prevention controls.
9	Almost every time	Prevention controls will have little effect in preventing failure cause.
8	More than once per shift	
7	More than once per day	Prevention controls somewhat effective in preventing failure cause.
6	More than once per week	
5	More than once per month	Prevention controls are effective in preventing failure cause.
4	More than once per year	
3	Once per year	Prevention controls are highly effective in preventing failure cause.
2	Less than once per year	
1	Never	Prevention controls are extremely effective in preventing failure.

Table 3 - Occurrence Matrix for FMEA

3.5 Detection

Detection is defined as the extent to which a failure can be identified before it produces a significant impact on operations. Within Tata Steel's supply chain, detection capability varies according to the degree of process visibility and the effectiveness of monitoring systems. Portrayed in table 4, failures such as documentation errors are generally identifiable at an early stage through administrative verification, whereas issues such as supplier quality non-conformities are more difficult to anticipate. Shown below in table 4, higher detection ratings

reflect a reduced organisational capacity to predict or mitigate potential failures prior to their effect on production activities.

Detection Potential (D) for the Validation of the Process Design			
D	Ability to Detect	Detection Method Maturity	Opportunity for Detection
10	Very low	No testing or inspection method has been established or is known.	The event is extremely difficult to predict, offering little to no warning. Detection usually occurs only after the risk has occurred, as the failure mode is not easily identified and cannot be reliably caught through random audits.
9		It is unlikely that the testing or inspection method will detect the failure mode	
8	Low	Test or inspection method has not been proven to be effective and reliable	Few indicators signal the impending risk, and detecting it often requires specialised data or advanced analysis. Standard human inspections or manual measurements may catch it, as can automated or semi-automated systems with alerts or precision inspection equipment.
7			
6	Moderate	Test or inspection method has been proven to be effective and reliable	Some warning signs exist but may be subtle, requiring careful, ongoing monitoring. Detection can be achieved through human inspections or manual measurements, as well as semi-automated systems or precision equipment, including sample checks.
5			
4	High	System has been proven to be effective and reliable	The risk shows clear, predictable indicators that can be monitored through standard processes, such as KPIs or relevant information sources. Automated detection systems identify failures downstream, halt processing, and route discrepant products to designated reject areas, ensuring they cannot leave the facility.
3			
2		Detection method has been proven to be effective and reliable	The risk is inherent and easily observed in operations. Basic monitoring can identify risk and automated systems can detect the cause and prevent production of defective parts.
1	Very high	Failure mode cannot be physically produced or processed, as detection methods proven to always detect the failure mode or failure cause.	

Table 4 - Detection Matrix for FMEA

3.6 Failure Mode and Effects Analysis on Imported Slab Supply Chain

The FMEA identified a number of high priority risks within the international steel slab import supply chain to Tata Steel Port Talbot. The analysis shown in table 4, demonstrated that shipping delays from adverse weather generated the highest Risk Priority Numbers (RPNs), indicating their considerable potential to disrupt production processes and compromise the continuity of customer supply.

Supplier related risks, linked to the quality of the product Tata Steel Port Talbot receive, were evaluated as severe due to their direct impact on the continuity of slab availability. This challenge is particularly critical during Tata Steel's transition to Electric Arc Furnace (EAF) operations, where the maintenance of a consistent slab supply is essential for meeting customer demand and ensuring operational stability.

Sustainability risks, including carbon intensive processes were assigned high ratings, reflecting the vulnerability of the supply chain to external factors such as financial penalties and reputational damage.

Customs and documentation issues were identified as exerting a moderate yet persistent influence on the supply chain. Errors in import documentation may lead to shipment delays and increased administrative costs. Quality control issues at the supplier stage were also observed and have the potential to become severe, since the delivery of substandard slabs could negatively affect downstream production quality and result in customer rejections.

Overall, the FMEA demonstrates that the slab import supply chain is vulnerable to both operational and strategic risks. To mitigate these threats and strengthen resilience, six key improvement steps are proposed in the next section.

3.7 Limitations of FMEA

The Failure Mode and Effects Analysis (FMEA) process is inherently qualitative and subjective rather than quantitative or strictly measurable. It depends heavily on the expertise, experience, and judgement of the assessment team, meaning that its accuracy and reliability are influenced by the team's collective knowledge and ability to identify potential risks (Banghart, Babski-Reeves, Bian, & Strawderman, 2018). As such, it represents a single-point failure analysis, focusing on individual failure modes in isolation rather than accounting for complex, interrelated or cascading failures that may occur across multiple points within a system (Shebl, Franklin, & Barber, 2012).

The FMEA serves primarily as a summary of the team's evaluations and decisions, rather than a direct measurement of system reliability or performance. Consequently, the overall quality and validity of the FMEA report are contingent upon the team's ability to record information clearly, comprehensively, and consistently. Variations in documentation quality, and interpretation among team members can therefore introduce bias or inconsistency, potentially limiting the predictive capability of the analysis when applied to future operational scenarios (Grainger, 2024).

4. Improving Resilience of Imported Slab Supply Chain

4.1 Imported Slab

During the transition from traditional blast furnace (BF) steelmaking to electric arc furnace (EAF) production at Port Talbot, Tata Steel UK has temporarily relied on the importation of steel slabs in order to maintain operational continuity (Tata Steel, 2024).

The decommissioning of the site's heavy-end assets, including the blast furnaces, has generated a production gap that would otherwise disrupt supply to downstream processing units and key customers. To mitigate such interruptions, Tata Steel has arranged the importation of slabs and hot-rolled coil from its sister plants in India and the Netherlands, as well as from other responsible global supply chains, thereby ensuring the continuity of manufacturing and distribution activities throughout the transition period (Nair, 2024).

The decision to import steel slabs during Tata Steel's transition carries significant implications for the resilience and efficiency of its international supply chain. This shift introduces additional logistical dependencies, as imported slabs must be sourced, transported, and stored under conditions that guarantee quality consistency with domestically produced material (John, 2025).

DB Cargo UK has played a central role in adapting its operations to support the transition, delivering efficient rail freight services for the transportation of heavy steel coils and slabs from various global sources to Port Talbot. Shipments predominantly arrive at Cardiff and Newport Docks before being transferred to Port Talbot, a process that requires meticulous coordination to safeguard supply chain integrity and uphold product quality standards (Cargo, 2025).



Figure 2 - DB Cargo Rail (Cargo, 2025)

This reliance on external suppliers heightens exposure to global market fluctuations, transport disruptions, and port congestion, particularly in light of the volatility associated with international shipping and raw material costs (Shane, 2025). Adverse weather conditions, customs delays, and shipping route constraints have the potential to impede the timely delivery of slabs, thereby disrupting the consistent supply of feedstock to Port Talbot's rolling mills and downstream operations (UN Trade & Development, 2024).

Stringent quality control is necessary to ensure that imported slabs conform to Tata Steel's metallurgical specifications, as any deviation has the potential to compromise downstream product performance or customer acceptance. From a strategic perspective, the incorporation of international slab supply routes illustrates adaptive flexibility within Tata Steel's supply network, allowing the company to sustain production and fulfil customer requirements despite the temporary reduction in domestic steelmaking capacity. This strategy represents a deliberate effort to preserve supply chain continuity, minimise operational downtime, and protect customer relationships while simultaneously progressing towards a low-carbon production model (Narendran, 2025).

4.2 Step One: Supplier Diversification

Reliance on a limited number of suppliers, or the maintenance of a concentrated supply base, presents significant risks to the resilience of global supply chains. When an organisation is heavily dependent on one or two suppliers for critical components, any disruption at these points can generate severe downstream consequences (Mitrastech Staff, 2023).

A notable example is the 2020 fire at the Renesas semiconductor plant in Japan, which disrupted the global supply of automotive microcontrollers. Several automotive manufacturers, including Toyota, Honda, and Nissan, were heavily dependent on Renesas, and the limited availability of alternative suppliers contributed to prolonged production delays (Thomas, 2021).

The lack of flexibility meant that, although alternative suppliers were available, they were unable to accommodate the sudden surge in demand, resulting in significantly extended lead times. The reduced supplier base heightened vulnerability to price fluctuations, as the scarcity of critical components drove costs upward. The disruption also produced cascading effects across the supply chain, influencing downstream suppliers and ultimately leading to delays in vehicle deliveries, lost sales, and customer dissatisfaction. This case illustrates how dependence on a limited supplier base can intensify the impact of unforeseen events and emphasises the importance of supply chain diversification and the implementation of risk mitigation strategies (Furukawa & Alpeyev, 2021).

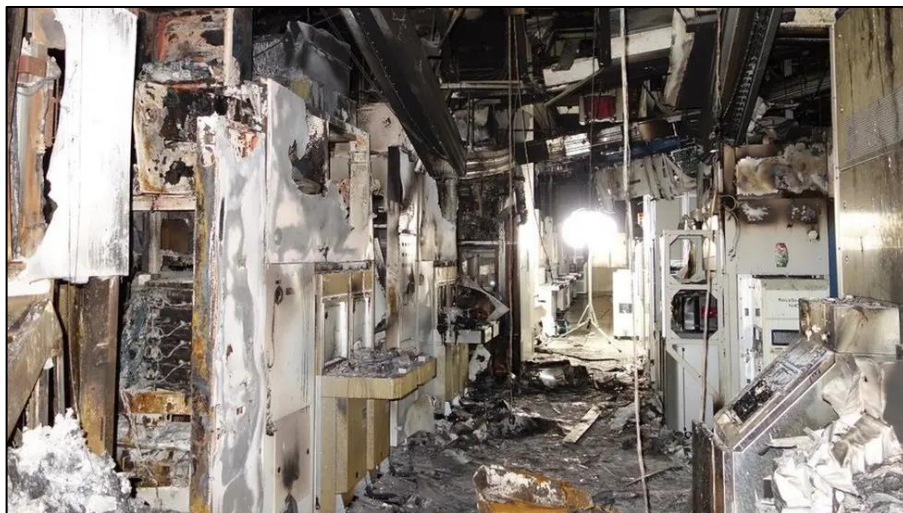


Figure 3 - Renesas Factory after fire damage (Kelion, 2021)

Tata Steel need to reduce its dependence on a limited number of international slab suppliers by developing alternative sourcing options across multiple regions. Diversification of the supplier base mitigates the risk of disruption arising from supplier insolvency, political instability, or capacity constraints. The establishment of framework agreements with secondary suppliers in Europe or Asia would help to secure continuous supply and contribute to greater price stability.

Although Tata Steel Port Talbot currently receives internal slab supplies from the company's plants in the Netherlands and India, the cultivation of relationships with a broader range of external suppliers would be advantageous. The Netherlands facility is facing increasing governmental pressure to adopt greener steelmaking practices. While the Port Talbot site has implemented an Electric Arc Furnace to sustain steel production, the Netherlands plant has received substantial investment to facilitate its transition towards hydrogen-based steelmaking (Fuel Cell Works, 2025). Although this development represents a positive step from an environmental perspective, it may lead to periods of downtime or delays in the coming years, with potential knock-on effects for Port Talbot's supply chain and customer deliveries. Consequently, it remains essential for Tata Steel Port Talbot to pursue further diversification of its supplier base in order to strengthen supply chain resilience.

4.3 Step Two: Strategic Stockholding and Buffer Inventory

The establishment of safety stock for imported slabs at Port Talbot would mitigate the effects of shipping delays and port congestion. Temporary stockholding can serve as a buffer during unforeseen disruptions, thereby enabling downstream production to continue without interruption. The use of digital inventory systems could optimise stock levels through demand forecasting and alignment with shipping schedules. Maintaining buffer inventory constitutes a critical strategy for strengthening supply chain resilience, as it provides protection against disruptions in supplier delivery (Roseburrough, 2025).

The maintenance of buffer stock enables operations to continue in the event of supplier delays, capacity constraints, or unexpected shutdowns, thereby ensuring production continuity and reducing the risk of lost sales. It also mitigates supplier-related risks, including strikes, natural disasters, and geopolitical events, while allowing firms to respond more effectively to sudden fluctuations in customer demand (Pettit, 2025).

The maintenance of safety stock can enhance negotiating power with suppliers by reducing dependence on immediate deliveries during periods of scarcity. Recent global events have demonstrated the adverse consequences of insufficient buffer inventory (Carrico, 2024). During the COVID-19 pandemic, numerous manufacturers operating under just-in-time inventory models were unable to secure critical components when factories in China and other countries closed. This resulted in widespread production halts, with particularly severe effects observed in the automotive and electronics sectors (McCracken, 2024).

Similarly, hospitals encountered critical shortages of personal protective equipment as a result of limited stock, which delayed the provision of protection for frontline workers. In the automotive sector, firms such as Ford, General Motors, and Toyota experienced production stoppages during the global semiconductor shortage, with those lacking buffer inventory facing prolonged delays and significant revenue losses (To, 2023). These examples illustrate that, although the maintenance of safety stock entails additional holding costs, the benefits in terms of operational continuity, risk mitigation, and flexibility are considerable, particularly during periods of global supply chain disruption.

4.4 Step Three: Enhanced Visibility and Digital Tracking

The implementation of real-time tracking technologies, such as Radio Frequency Identification (RFID) and Global Positioning (GPS) systems, can enhance visibility across all stages of slab transportation. These systems enable Tata Steel to monitor vessel locations, estimate arrival times, and identify potential delays, thereby supporting more effective logistics management and supply chain coordination.

Enhanced visibility facilitates proactive decision making and improved coordination among logistics, procurement, and production teams. The integration of digital tracking technologies and supply chain visibility tools offers considerable advantages by delivering real-time insights into the movement of goods, inventory levels, and supplier performance throughout the entire supply network (SAP, 2024).

Such capabilities allow organisations to identify potential disruptions, delays, or bottlenecks at an early stage, thereby facilitating proactive decision-making and reducing operational risk. Enhanced visibility also contributes to more effective inventory management by lowering the probability of stockouts or overstocking, and by enabling data-driven replenishment strategies (Verma, 2025).

Furthermore, enhanced visibility strengthens organisational responsiveness and agility by enabling timely adjustments to production schedules, the rerouting of shipments, and the rapid substitution of suppliers in reaction to unforeseen events.

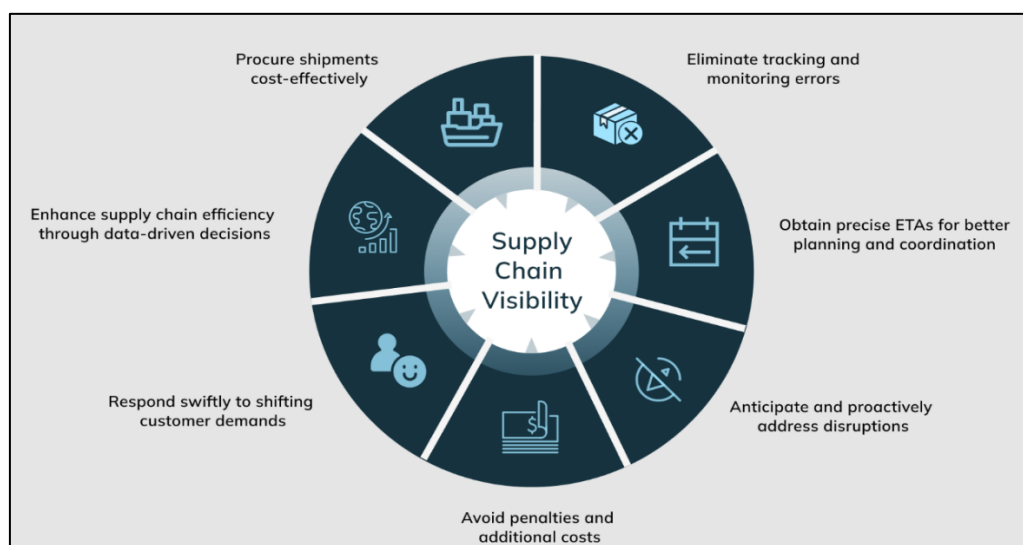


Figure 4 - Supply Chain Visibility (Verma, 2025)

Leading organisations have demonstrated the advantages of implementing such systems. For example, Walmart employs real-time inventory tracking to respond swiftly to fluctuations in demand, particularly during periods of heightened activity such as the COVID-19 pandemic. This approach has enabled more agile and informed decision-making in the face of supply chain volatility (Greenspan, 2024). Also, Zara employs digital tracking to manage its fast-fashion supply chain efficiently, ensuring rapid replenishment of popular items (Bain, 2023).

These examples highlight that enhanced supply chain visibility contributes not only to improved operational efficiency but also to greater resilience. By providing timely and accurate information, such visibility enables organisations to anticipate potential challenges and respond to disruptions with increased agility and effectiveness.

4.5 Step Four: Supplier Collaboration

The development of closer relationships with key suppliers can promote greater transparency and reliability within the supply chain. Practices such as regular performance reviews, joint quality audits, and the sharing of production schedules assist in anticipating potential bottlenecks. Collaborative engagement also facilitates the early detection of quality or capacity issues, thereby enhancing communication and trust across supply chain partners. Fostering collaboration throughout the supply chain yields substantial benefits by improving coordination, communication, and operational efficiency among all stakeholders, from suppliers to end customers (Teuchler, 2025).

For Tata Steel Port Talbot, which is dependent on imported steel slabs, close collaboration with international slab suppliers, logistics providers, and internal operational teams is essential to maintaining a consistent and reliable supply of raw materials. Collaborative planning enables alignment of production schedules, the sharing of demand forecasts, and the coordination of deliveries, thereby reducing the likelihood of delays, stockouts, or excess inventory. Collaboration also supports rapid problem-solving in the face of disruptions such as shipping delays, customs clearance challenges, or quality issues by allowing stakeholders to implement contingency measures collectively rather than in isolation. (Weiss, 2023).

Examples from other industries demonstrate the strategic value of supply chain collaboration. Following the 2011 earthquake and tsunami in Japan, numerous automotive manufacturers encountered significant disruptions due to the abrupt unavailability of essential components. Organisations that had established collaborative relationships with suppliers were more successful in identifying alternative sources and mitigating production losses. In contrast, firms with limited supplier engagement experienced extended operational shutdowns (Schmidt & Simchi-Levi, 2013).

Similarly, within the food retail sector, Kroger's collaborative planning with suppliers facilitated more effective management of inventory and distribution during the COVID-19 pandemic. This approach ensured the continued availability of essential goods despite significant surges in consumer demand (Acosta, 2021).

In the context of imported steel slabs, collaborative engagement could enable Tata Steel Port Talbot to coordinate effectively with suppliers based in Europe and Asia. Such coordination

would support the anticipation of production and shipping delays, the exchange of real-time information regarding slab quality and availability, and the alignment of internal production schedules. These practices collectively contribute to reducing risks to downstream operations and ensuring the timely fulfilment of customer deliveries.

4.6 Step Five: Documentation and Customs Compliance

The implementation of digital document management and pre-clearance systems can significantly reduce customs delays and minimise human errors associated with import documentation. Furthermore, providing training for administrative personnel and suppliers in international trade compliance enhances the efficiency of port clearance processes and mitigates the risk of shipment rejections or incurring penalty charges (Embracing Digital Transformation: The Role of Technology in Modernising Customs Clearance Processes, 2025).

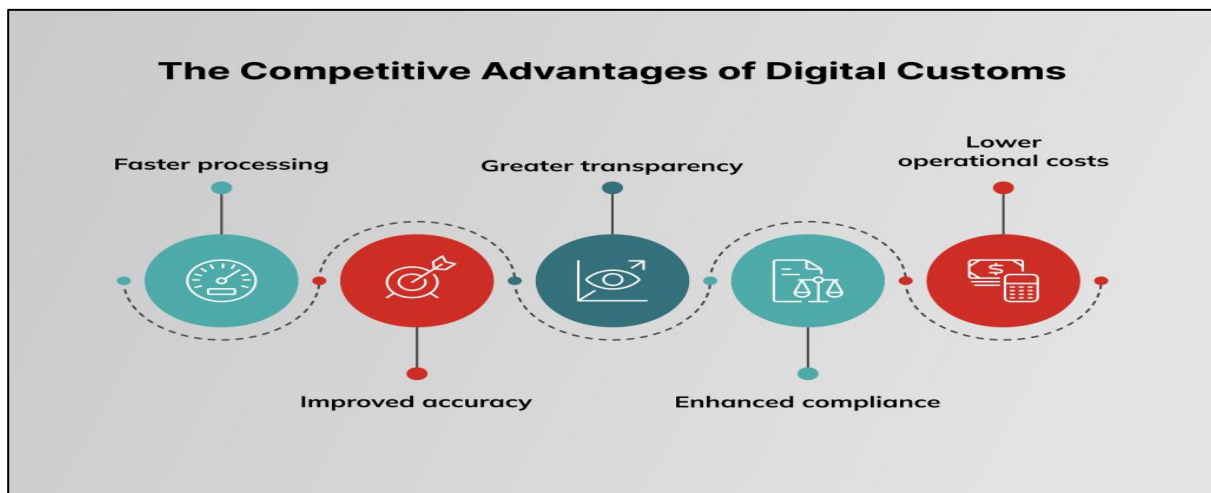


Figure 5 - Advantages of Digital Customs (Embracing Digital Transformation: The Role of Technology in Modernising Customs Clearance Processes, 2025)

Improved documentation and stringent customs compliance are critical to sustaining the uninterrupted flow of imported goods, particularly in the case of Tata Steel Port Talbot, which depends on the importation of steel slabs. The provision of accurate and comprehensive documentation such as certificates of origin, customs declarations, and quality certificates facilitate efficient customs clearance and ensures adherence to relevant regulatory requirements ("How to Stay Compliant with Customs and Import Rules for Steel Products", 2025).

This approach reduces the likelihood of delays at ports, financial penalties, or the confiscation of goods, all of which have the potential to disrupt production schedules and downstream operations. For Tata Steel, the accurate documentation of steel slabs imported from suppliers in Europe and Asia is especially critical, given the substantial volume, weight, and regulatory scrutiny associated with such imports. Robust customs compliance further supports the

forecasting of delivery timelines, the negotiation of transport contracts, and the maintenance of cost predictability across the supply chain (Gosain, 2023).

Examples from other industries demonstrate the consequences of inadequate documentation and insufficient customs compliance. In late 2023, UPS encountered significant difficulties in clearing international shipments through U.S. customs as a result of missing or incomplete information. Consequently, thousands of packages were delayed, and some were destroyed after failing to meet clearance requirements. This case highlights the critical importance of accurate and comprehensive customs documentation in sustaining efficient supply chain operations (Morales, 2025).

For Tata Steel Port Talbot, the implementation of rigorous documentation procedures and full adherence to customs compliance requirements would mitigate the risk of comparable disruptions, thereby ensuring the timely arrival of imported slabs, the continuity of production, and the fulfilment of customer demand. Strengthened documentation and compliance practices function as a preventive mechanism, enhancing supply chain reliability, reducing operational risks, and minimising the likelihood of costly delays.

4.7 Step Six: Sustainability Strategy

Adopting sustainability oriented and risk-aware procurement practices offers substantial strategic and operational benefits for organisations operating within complex global supply chains, such as Tata Steel Port Talbot's reliance on imported steel slabs.

The integration of sustainability criteria into supplier selection supports both environmental objectives and long-term supply reliability. Prioritising suppliers committed to low-carbon production, ethical sourcing, and robust governance enhances resilience against prospective regulatory or reputational risks. Aligning procurement practices with Tata Steel's decarbonisation strategy strengthens long-term competitiveness and secures supply continuity (Why Sustainable Procurement Is Essential for Resilient Supply Chains, 2025).

Sustainable procurement entails sourcing materials with consideration of environmental, social, and governance (ESG) factors, while risk-aware procurement requires the evaluation of suppliers against operational, financial, and geopolitical risks prior to engagement. For Tata Steel, the integration of these principles into the importation of slabs from international suppliers serves to mitigate potential disruptions arising from environmental regulations, ethical concerns, or supplier instability. In addition, such practices reinforce corporate commitments to carbon reduction and responsible sourcing, which are of growing importance in light of increasing customer expectations and regulatory scrutiny of the steel industry's environmental impact. (Jaber, 2025).

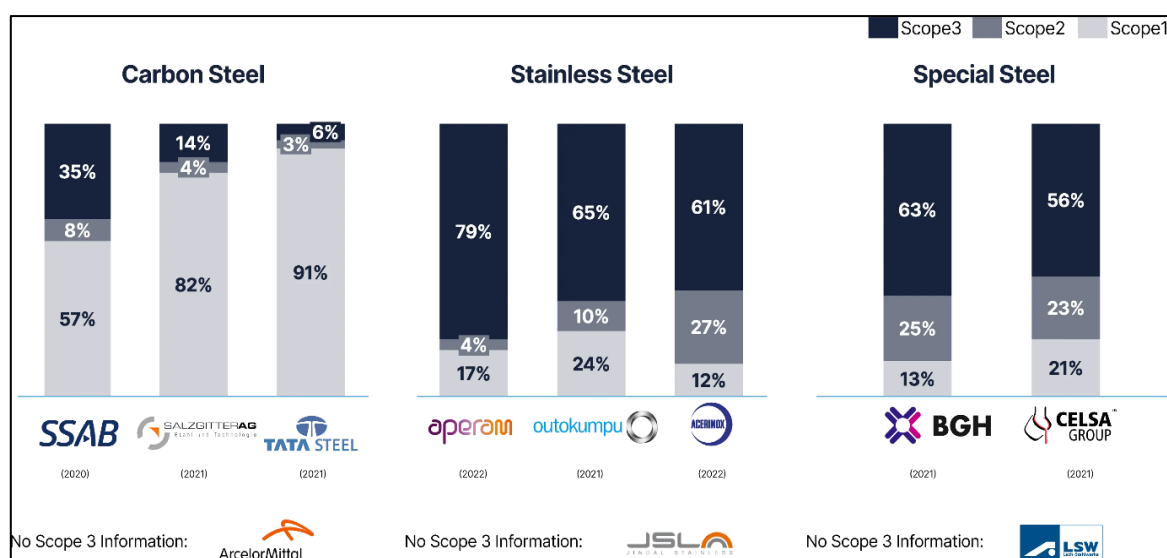


Figure 6 – Percentages of Green Steel from various business's (Jaber, 2025)

One key advantage of sustainability-focused procurement is the mitigation of regulatory and reputational risks. By ensuring that suppliers comply with environmental standards and labour regulations, Tata Steel is able to minimise exposure to potential fines, import restrictions, or adverse publicity arising from unethical practices or non-compliance with environmental requirements (Rice, 2025).

Risk-aware procurement further enables organisations to diversify their supplier base both geographically and operationally, thereby reducing dependence on single points of failure and mitigating vulnerabilities arising from political instability, natural disasters, or factory shutdowns (Tata Steel, 2019).

Examples from other industries illustrate the consequences of disregarding sustainability and risk considerations. An instance of this is the fast-fashion retailer H&M experienced substantial reputational damage when suppliers in Bangladesh and Cambodia were found to be in violation of labour standards, resulting in consumer backlash and heightened scrutiny from non-governmental organisations (NGOs) (Hitchings-Hales, 2018).

In the electronics sector, Apple experienced supply chain disruptions and reputational criticism arising from the sourcing of cobalt from mines in the Democratic Republic of Congo that were associated with child labour and unsafe working conditions. These issues required urgent remediation measures and the implementation of costly audit processes (Zenda, 2024).

For Tata Steel Port Talbot, the integration of sustainability and risk-aware practices into the procurement of imported slabs would not only reinforce supply chain resilience but also enhance corporate responsibility, ensure compliance with evolving environmental regulations, and safeguard the company's reputation. Through the systematic assessment of supplier practices, environmental impact, and operational risks, Tata Steel is able to manage potential disruptions proactively while aligning procurement activities with broader ESG objectives.

5. Conclusion

The project has examined the international supply chain for steel slab imports to Tata Steel Port Talbot, emphasising its critical importance during the transition to Electric Arc Furnace (EAF) steelmaking. Through the application of Failure Mode and Effects Analysis (FMEA), several key risks were identified, including supplier shortages, shipping delays, and supplier insolvency, each of which has the potential to cause significant disruption to downstream production.

The findings highlight that effective risk management and the development of supply chain resilience are critical to sustaining operational continuity and fulfilling customer demand. The six proposed resilience strategies offer a structured framework designed to enhance supply security.

By adopting these measures, Tata Steel can mitigate its exposure to global supply chain volatility and facilitate a stable, efficient, and sustainable transition towards low carbon steelmaking. The study underscores the significance of proactive planning and continuous improvement as essential mechanisms for securing long term competitiveness within an increasingly dynamic and uncertain global market.

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