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1. Introduction & Project Background

The project in question relates to a world leading steel manufacturing company in the UK that employs in excess of 8,000 people to manufacture over 3 million tonnes of steel each year (Tata Steel, 2023). Specifically, it is the plant facility responsible for packaging and generation of tin plate, involving secondary processing of yields of steel strip coil such as; treatment with chemicals/heat, and additional gauge reduction producing tinplate, electro chromium and plastic laminated steel products that is impacted (Tata Steel , 2023).

Following several near misses and incidents relating to unsafe and unsecured points of isolation for services, the company has set a business standard to control the risk to all personnel working under isolation or immobilisation, and secure physical precautions. Initially a project task force was assembled to ensure that all electrical and mechanical points of isolation, immobilisation and other physical precautions were to be secured by means of a unique lockable device and danger tag, more commonly known as Lock Off Tag Off, LOTO.

Following on from successful implementation of LOTO, a review of residual risk identified additional levels of control needed to be implemented in order to comply with HSE guidelines. A new project task force was assembled to implement further controls involving securing of safety keys, with use of personal isolation equipment. Uniquely owned padlock and identification tag are to be applied by all personnel to secure physical precautions in place, commonly referred to as One Person One Lock, 1P1L.

As shown in the process flow diagram for 1P1L below, the system sets out to expand the safe isolation of LOTO. Both electrical and mechanical isolations will be secured by means of a unique key lockable device, padlock and danger notice; red padlock for electrical isolations, blue padlock for mechanical isolations. The unique safety keys will be placed in a secured lock box, which will be further secured by uniquely keyed padlocks; green for permit issuer and orange for each working parties' working party leader, WPL. Upon issuing a permit to work to the WPL, the issuing authority, IA, will issue a personal lock box to the individual working parties, where the WPL's key for the orange lock will be placed. The IA will then apply a further uniquely keyed lock (green padlock) to the individual lockbox. All of the IA's unique keys for green padlocks will be stored in a secure location, under the control of the IA. Each member of the working party will apply their own uniquely keyed yellow padlock to the working party group lock box, with each member required to keep their personal safety keys upon their person.

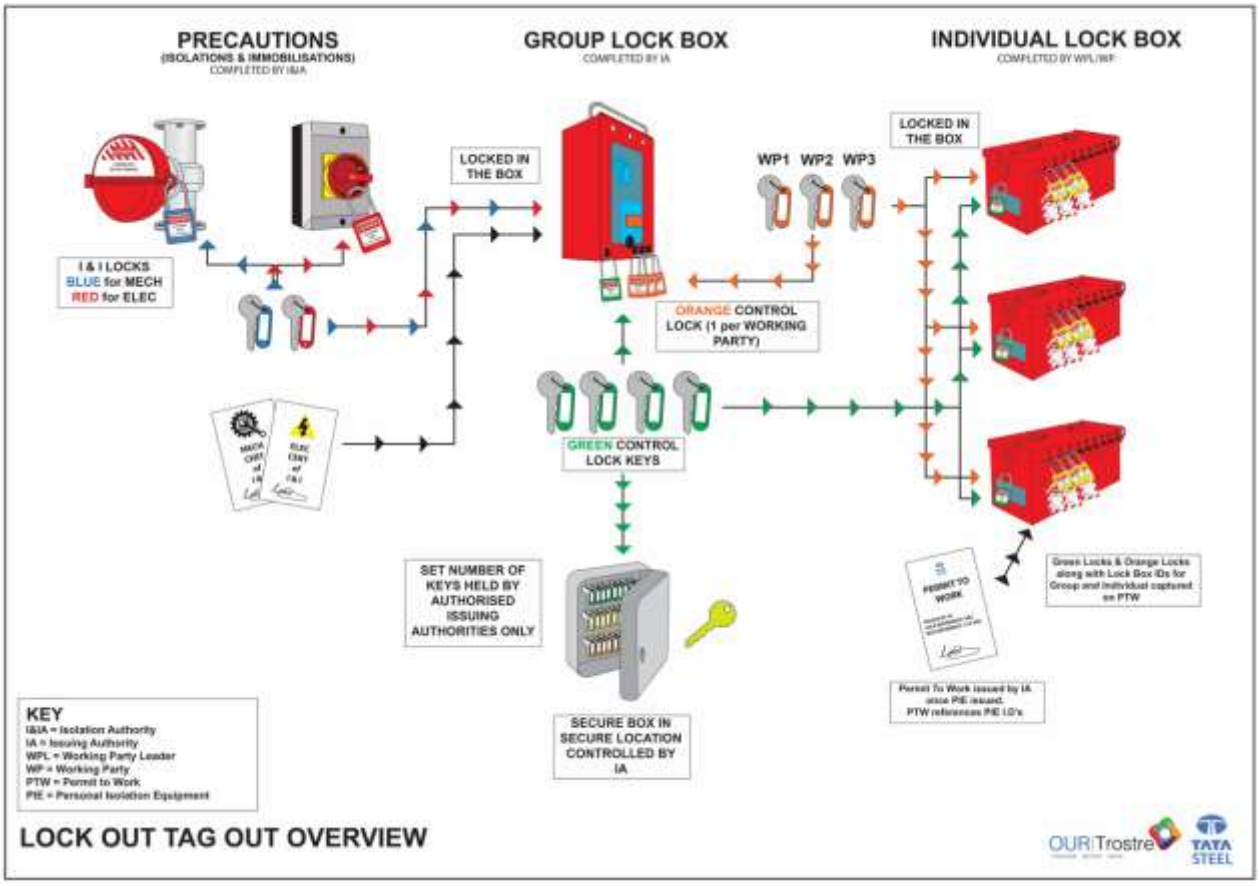

Figure 1 - 1P1L Project Overview

(Tata Steel, 2023)

The process of 1P1L will apply to all working parties, ensuring safety from mechanical and electrical stored energy under the provided isolations. No single working party lock box will be able to be returned to the IA for permit cancellation, until all working party members have removed their personal yellow padlocks. All electrical and mechanical isolations will remain secure until all working parties have returned the individual lockbox and cancelled the permits.

2. Project Activities

Project activities are specific tasks and actions performed to achieve project objectives. They are an essential component of project management, viewed as building blocks of a project plan. Activities identified during the planning phase are able to be assigned, scheduled and monitored throughout the project lifecycle, (Sharma, 2023). Activities can significantly differ, depending on the nature of the project. However some commonalities will be evident for all projects such as; task identification, where tasks and activities will be identified and allocated, task and activity definition, where identified task and activities are defined, specifying their individual scopes, deliverables and dependencies, and scheduling, where identified tasks and activities are scheduled for a set duration with considerations to project timeline, resources and deadlines, (Antonio, 2023).

Figure 2 - Project Activities

(Kashyap, 2020)

2.1. Network Diagram

A network diagram is a graphical representation of sequence and interdependencies of project tasks and activities. It forms a visual tool designed to create logical workflow, revealing relationships between various tasks and activities which allows project managers to plan, schedule, control and execute complex projects. Network diagrams are also used to identify the project's critical path, a requirement that determines the minimum completion time of the project by identifying the longest sequence of dependant activities. (Suresh, 1994)

The main methods used to create network diagrams are Arrow Diagram Method, (ADM) and Precedence Diagram Method, (PDM). (Gabriel, 2009), both of which visually map the project's schedule. In ADM, arrows are used to represent activity duration, illustrating the activities flowing from one to another, and events are represented by nodes. ADM diagrams emphasise sequence of activities and their logical relationships. (CPM Scheduling, 2022). In PDM, nodes represent activities and arrows represent dependencies. PDM focuses on displaying relationships between activities and allows more flexibility, representing different dependency types, such as start to finish, start to start, finish to start, and finish to finish. (Adobe Experience Cloud Team, 2023)

Dependency Type		Dependency Description
Start to Start	S-S	The dependent task cannot begin until the task it depends on has started.
Start to Finish	S-F	The dependent task cannot finish until the task it depends on has started.
Finish to Start	F-S	The dependent task cannot start until the task it depends on is finished.
Finish to Finish	F-F	The dependent task cannot finish until the task it depends on is finished.

Table 1 - Type of Dependencies

(Gabriel, 2009)

During the planning phase and in order to create a network diagram, a project activity schedule is required. The project activity schedule, as shown in appendix 11.1., lists each activity and associated timeline required to complete the project (ProjectManager.com, Inc., 2024). For each activity, project milestones are also identified; a particular point in the project development to measure progress in terms of timeline, budget checks and deliverable objectives (Harned, 2023).

Following the project schedule, a network diagram schedule is created. This schedule as shown in appendix 11.1. identifies tasks and activities, highlighting which tasks are required to be done within their required timeframe in order for the next task and activity to begin; known and project dependencies.

The network diagram illustrated below and shown in appendix 11.2., identifies tasks and activities that are placed on the project's critical path. The critical path indicates the project's shortest timeframe from beginning to completion, as well as the chronological sequence. Tasks and activities not on the critical path have estimated earliest start and finish days, as well as any necessary slack (F. K. Levy, 1963).

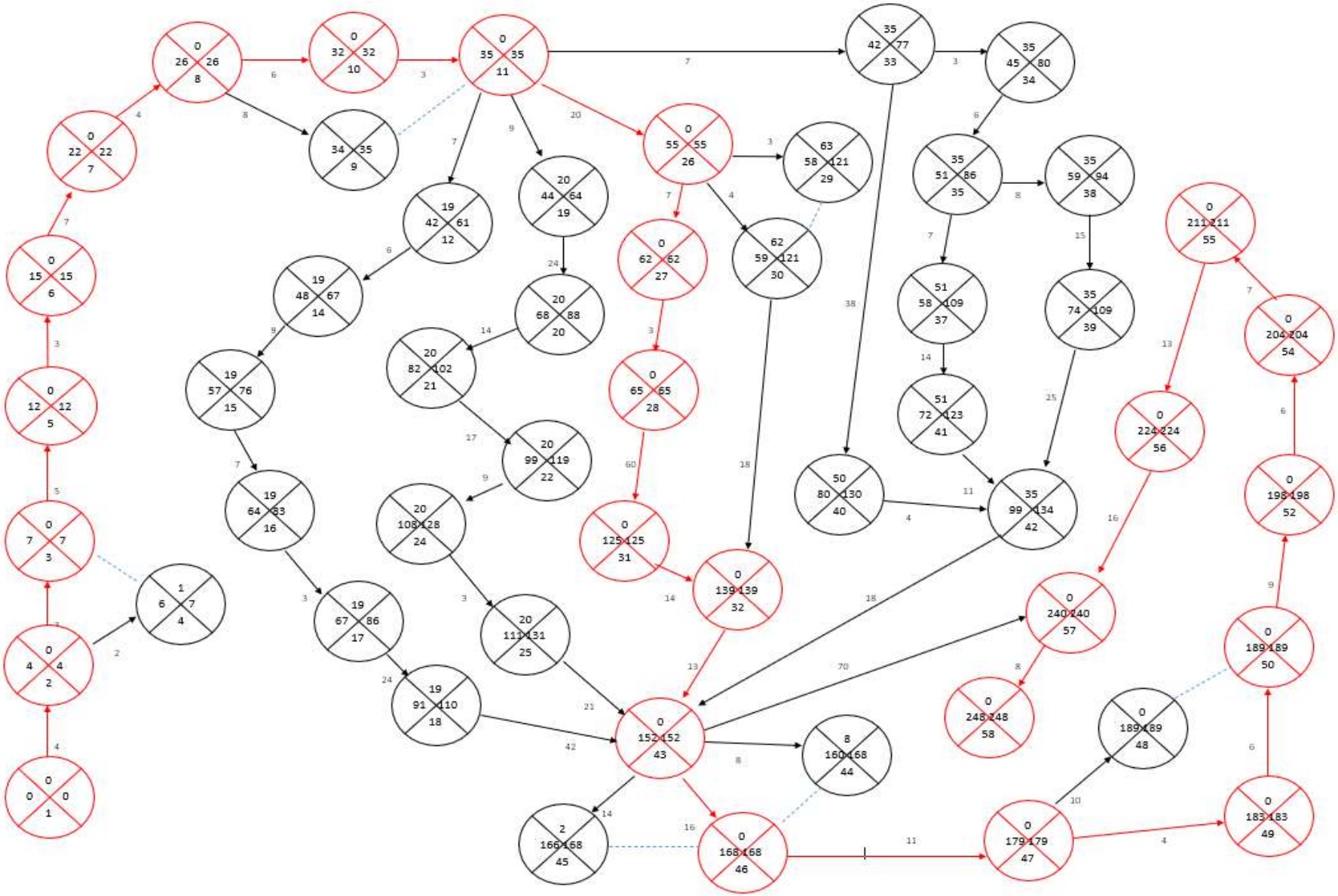

Figure 3 - Network Diagram

2.2. Gantt Chart

A Gantt Chart is a comprehensive project management tool, offering a visual representation for project planning, schedule, monitoring and progress. Gantt charts serve as timelines that illustrate planned start and finish dates, whilst providing a clear and organised representation of project tasks and activities with their respective timelines, dependencies and resource allocation. Gantt charts allow project managers to organise and understand the sequence in which tasks should be executed, ensuring a logical flow and preventing potential bottlenecks and delays. (Geraldi, 2012)

Gantt charts are essential when communicating with project teams and stakeholders. The visual representation is able to simplify complex schedules, allowing for team members to understand roles, responsibilities and deadlines. An insight to stakeholders of the project's progress also allows for informed decision making, facilitation of effective communication, enhancement of project co-ordination, and contribution to overall project success. (Shweta, Cassie Bottorff, 2022)

The devised Gantt chart for 1P1L, as illustrated in the image below and appendix 11.3, was devised following creation of the activity schedule and network diagram. Each activity and task represent a relevant step, inclusive of project milestones. Each task has a planned start date and anticipated duration within the project schedule. As the project progresses, the Gantt chart will be updated regularly to reflect progress, identifying activities and tasks that are completed, underway, overrunning and yet to commence.

Project Planner - Trostre's 1 Person 1 Lock System

Year :2024

Period Highlight | % Complete | Actual (beyond plan) | % Comple

	ACTIVITY + = Key Milestone	PLAN START WEEK	PLAN DURATION WEEK	ACTUAL START WEEK	ACTUAL DURATION WEEKS	PERCENT COMPLETE
1	Develop detailed scope of work	14	1			0%
2	+ Sign off scope of work	15	1			0%
3	Develop project plan	15	1			0%
4	Select & pull together team	16	1			0%
5	+ Confirm financial arrangements	16	1			0%
6	Develop initial comms	17	1			0%
7	Deliver comms sessions	18	2			0%
8	Develop Trostre policy for 1P1L	20	2			0%
9	Consultation period & peer review for policy	19	1			0%
10	Failure testing system (hypothetical)	20	1			0%
11	+ Sign off	20	2			0%
12	Develop training	21	2			0%
13	Review central training	21	2			0%
14	Review Trostre existing training requiring updates.	22	2			0%
15	Trial training/ develop/ include FAQs	24	1			0%
16	Failure testing system (practical)	25	1			0%
17	+ Sign off training	25	5			0%
18	Deploy training	30	9			0%
19	Complete operational area isolation point reviews	22	2			0%
20	Plan & complete improvement work for lock points in operational area	23	5			0%
21	Complete area 4 isolation standards reviews	27	3			0%

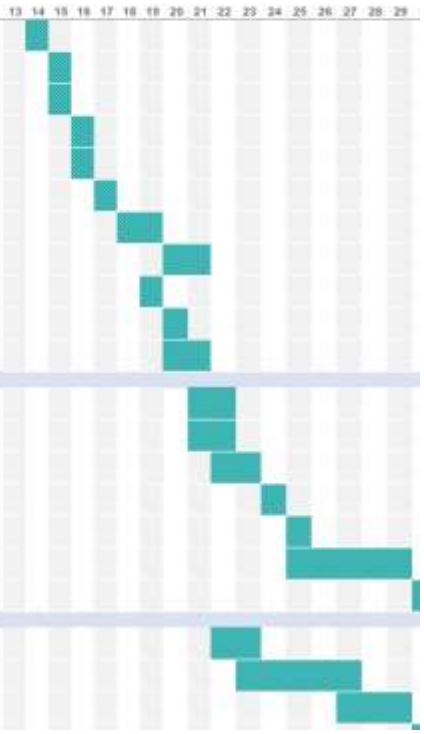

Figure 4 - Project Gantt Chart

3. Role of Communication

Effective communication plays a vital role project success. Clear and concise communication is essential for establishing project vision and objectives. Successful project managers communicate expectations, activities and goals to the entire project team, ensuring all members are aligned with the primary purpose and understanding of the required outcomes (Zulch, 2014). It is also crucial for defining roles and responsibilities. With clear and concise communication, project managers can empower, motivate and inspire teams, enabling better understanding of roles and responsibilities, fostering a sense of purpose and understanding among team members (Zulch, 2014).

Figure 5 - Communication

(Thamir, 2023)

Regular team meetings, status reports and feedback sessions are vital communication tools, allowing project managers to monitor progress and identify risks. Effective communication is crucial for managing and addressing risks, allowing project managers to implement mitigation strategies and contingency plans, reducing any negative impact on project timelines and deliverables (Schwartz, 2023). Engagement and communication with project stakeholders is also essential for project success. Regular updates and transparent interaction build professional relationships, help manage expectations and address concerns. Project success is not solely determined by technical skills and project planning, but also by effective and concise commination throughout the project lifecycle. (Guinan, 2023).

Daily and weekly project meetings are planned to take place with the project team during the lifecycle of the project. The meetings will maintain stakeholders' awareness of project progress, deliverables and required actions. Daily morning meetings will be scheduled aiming to discuss requirements of the day as well as any troubles or issues encountered the previous day. Weekly meetings will be scheduled in order to update project documentation such as project schedule, budget, progress, deliverables and the project team's to-do's and completed activities. Shared work folders by means of company IT databases are to be created for the project team to have access to all of the required project documentation, enabling an overview of project activities as well as enabling the project team to be organised and efficient (Muszyńska, 2022).

High level communications with company stakeholder will be scheduled during the lifecycle of the project, ensuring engagement is maintained throughout. These are anticipated to take place during the achieving of project milestones or in the event of incidents or project slippage. Further communication sessions with all stakeholders are planned to take place during the project lifecycle, by means of communication sessions, peer reviews, training sessions, trials, project roll out and auditing and support sessions.

4. PERT Analysis

Program Evaluation and Review Technique (PERT) is a project management tool developed to aid planning, scheduling and control of complex projects. Its primary objective is to provide a systematic and structured approach to project planning, generating an estimate of the time required to complete each activity and identifying the critical path (Shopify, 2022).

PERT requires the use of timescales, where activities are allocated three-time estimates, optimistic, pessimistic and most likely. These estimates assist with considering uncertainties and variations that can occur during project execution and are used to calculate expected duration and identification of the critical path. Activities on the critical path have no flexibility with time, with any delay directly impacting project duration (F. K. Levy, 1963).

A key feature of PERT is its ability to manage uncertainties and risk inherent in complex projects. By incorporating the three-times estimates, it provides a more realistic and flexible scheduling approach. Despite its strengths there are limitations; it can be overly complex for smaller projects, where whilst beta distribution for task and activities are assumed, this may not correctly reflect actual task and activities durations (CFI Team, 2023).

From the devised activity schedule and network diagram, recognised tasks and activities on the critical path are analysed using PERT. As shown in the table below, each task and activity is allocated additional timeframes; optimistic, the quickest the work can be completed, and pessimistic, an allowance of troubles and issues that are previously unforeseen. Most likely is the previously estimated timeline when devising the projects activity schedule.

Of the twenty-five activities on the critical path, nine of the activities (highlighted) have a higher PERT value than the estimated most likely value, meaning these are at risk of taking longer to complete than the estimated most likely value. These tasks will need additional monitoring and control when being implemented to limit the impact of delays and/or bottlenecks on the project. Although each are only marginally greater than the most likely value, slippage in the timeline can cause an estimated overall delay of 9 days, increasing the likelihood of the project overruns, namely not completed on time, or within the allocated budget. (Guthrie, 2023).

Critical Path Activity Schedule		Duration (Days)	Optimistic	Most Likely	Pessimistic	PERT Value	Likely Duration
1	2	4	2	4	5	3.8	4
2	3	3	2	3	4	3.0	3
3	5	5	4	5	9	5.5	6
5	6	3	2	3	4	3.0	3
6	7	7	4	7	9	6.8	7
7	8	4	3	4	8	4.5	5
8	10	6	5	6	8	6.2	7
10	11	3	2	3	6	3.3	4
11	26	20	15	20	24	19.8	20
26	27	7	4	7	10	7.0	7
27	28	3	2	3	4	3.0	3
28	31	60	54	60	65	59.8	60
31	32	14	11	14	16	13.8	14
32	43	13	11	13	18	13.5	14
43	46	16	11	16	20	15.8	16
46	47	11	8	11	18	11.7	12
47	48	10	7	10	16	10.5	11
47	49	4	3	4	6	4.2	5
49	50	6	4	6	8	6.0	6
50	52	9	6	9	12	9.0	9
52	54	6	4	6	11	6.5	7
54	55	7	4	7	10	7.0	7
55	56	13	10	13	16	13.0	13
56	57	16	12	16	20	16.0	16
57	58	6	4	6	8	6.0	6
Total Days		256	194	256	335	258.8	265

Table 2 - PERT Analysis

5. Risk Management Techniques

Risk management is a critical aspect of project activities and management, playing a pivotal role in ensuring successful project outcomes. It involves identifying, assessing, prioritising and mitigating potential risks that can impact project outcomes. Effective risk management techniques are essential for minimising uncertainties and maximising the probability of project success. A key technique for risk management is risk identification, where risks are systematically identified and documented by various techniques, such as brainstorming sessions, expert analysis or examination of historical data (Juliane Teller, 2014) (Schwalbe, 2015).

Identified risks are subject to qualitative and quantitative risk assessment techniques, where risk ratings are assigned. Qualitative assessment involves subjective judgment, whilst quantitative methods use numerical data for more precise evaluation (Juliane Teller, 2014).

Risk mitigation and contingency planning are crucial techniques to reduce the impact of potential risks, involving developing strategies, plans and contingencies to eliminate or minimise likelihood and impact of identified or unforeseen events. Mitigation strategies can include risk avoidance, transfer, reduction, and acceptance. Continuous communication, monitoring and control are integral to effective risk management (Norma L. Nielson, 2005)

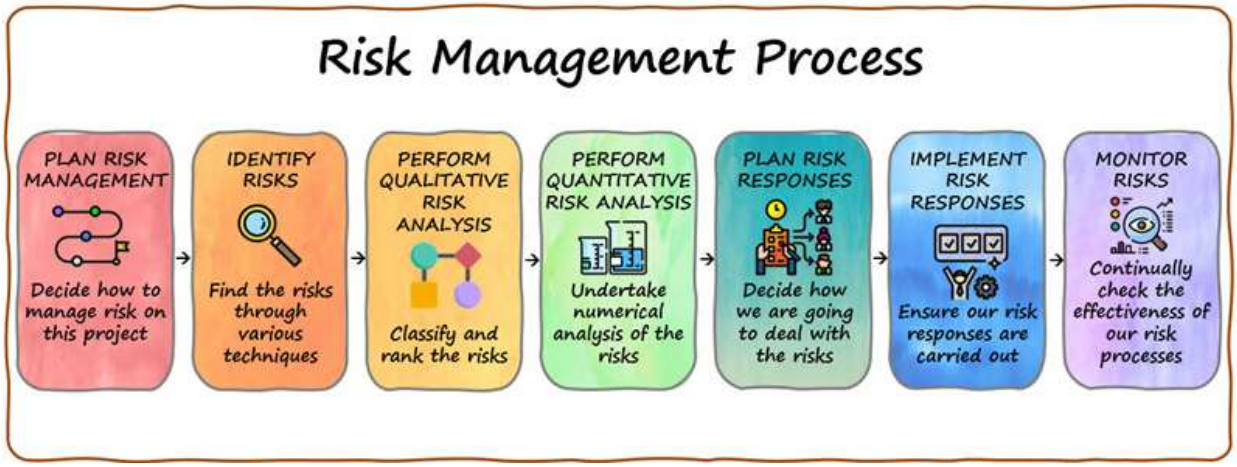

Figure 6 - Risk Management Process

(PMP, 2024)

For the projects risk management plan, identified tasks and activities are subject to a risk management process and allotted risk categories, such as technical, management or financial. The identified risks are then analysed for their probability and impact. Following this process each risk will have a plan for mitigation, as well as implementing the required response. Finally, each risk will require monitoring; tracking the identified risks, identifying and analysing any new risks, and reviewing the implementation and effectiveness of the agreed risk responses (Huo, 2023). See appendix 11.4 for Risk management.

6. Project Costing

Project budgets are a key constraint, second only to allotted duration, with projects required to adhere to allocated budgets (Mariana L. Alvaro, 2005). Effective project management involves thorough planning, execution, and control of various activities to achieve project goals, a key aspect of which is understanding and managing costs associated with individual activities as well as the overall project (Jaakko Kujala, 2014)

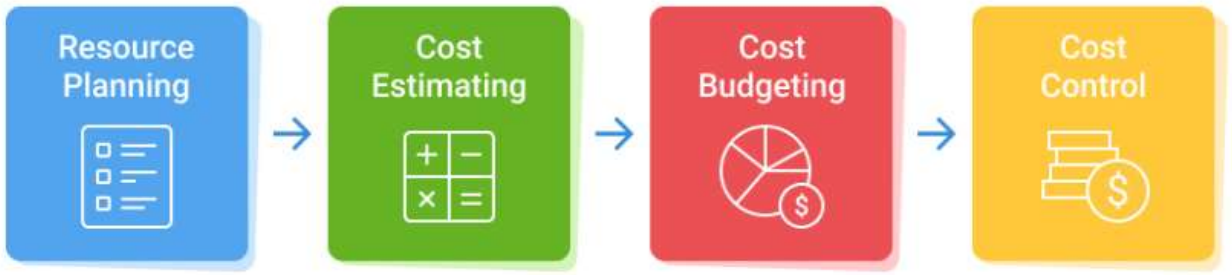

Figure 7 - Project Cost Management Phases

(Actitime, 2021)

Following the cost management phases of planning, estimates, budgets and control (Actitime, 2021), (as above) the project's allocated £450,000.00 budget is required to be prioritised and allocated. From the devised activity schedule and Gantt chart, a project costing table is developed as shown in appendix 11.5.

For each identified task and activity, an estimated requirement of either a worker, costed at £115.00 per day, contractor, costed at £165.00 per day or Manager/Supervisor costed at £200.00 a day is to be allocated and budgeted. As the project consists of a multitude of tasks and activities, each with its unique requirement of different resources, cost requirements will vastly differ.

An estimated allocation of the required resources is added to each task and activity, creating each activity's budgeted cost, close monitoring and control of costs being essential to ensuring the project remains within budget. Controlling the cost allow for planning, estimating and budgeting phases to be effective and accurate throughout the project's lifecycle (Yaqi Li a, 2022).

7. Crash Costing Techniques

Project management requires application of crash costing methodologies, especially in situations where time is of the essence. The primary objective of crash costing is to compress the project timeline without compromising the quality of deliverables (Suresh, 1994). Crash costing techniques are particularly common in sectors such as manufacturing, software development, and construction where time-to-market is crucial. A key element of crash costing is identifying critical paths within the project network, by pinpointing critical paths, project managers can ensure that their crash costing efforts are concentrated on the most time-sensitive tasks and activities (Suresh, 1994).

A thorough cost benefit analysis is essential to determine feasibility of crash costing, cost implications of accelerating the project are evaluated and assessed, allowing for informed decisions to be made, with regards to direct (increased labour, material and equipment) and indirect (overtime pay, increased risks and potential rework) financial impacts (Zaluski, 2023). Mathematical models such as Time-Cost trade off curve (TCT) are used to visualise relationships between time and cost. TCT curves demonstrate trade-offs between project duration and associated costs, assisting in identifying cost effective and time efficient routes for project completion. Project managers are able to make informed decisions regarding the extent of crash costing required in order to achieve the desired timeline

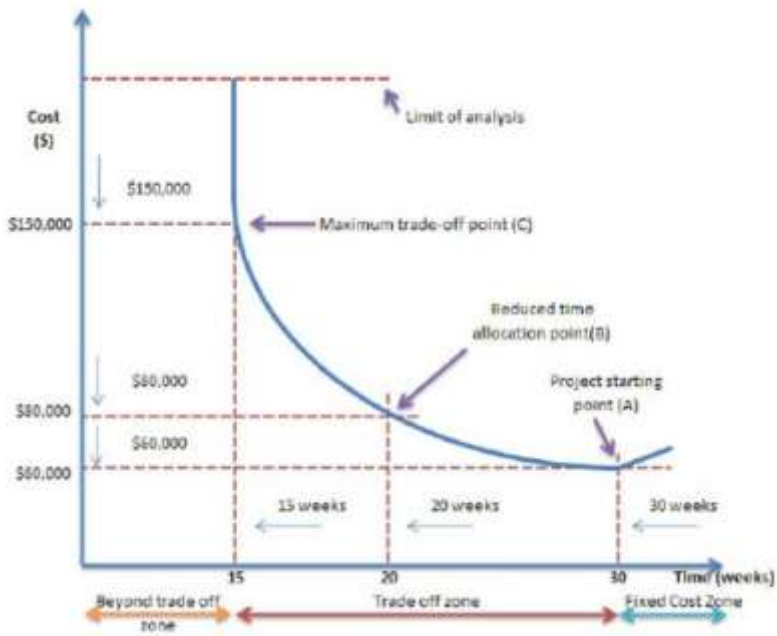

Figure 8 - Crash Costing Timeline Curve

(V.Kelly, 2009)

For the feasibility of reducing the project timeline by crash costing, activities and task suitable for crash costing are required to be methodically identified. To reduce the overall timeline, tasks and activities placed on the critical path need to be reduced, the reduction of which must be carried out with the goal of reducing, but not altering the critical path.

Activity		Planned Duration (Days)	Crashed Duration (Days)	Crashed Days	Planned Cost	Crashed Cost	Cost Increase	Cost Increase (Daily)
11	26	20	17	3	£8,000.00	£10,300.00	£2,300.00	£766.67
21	22	17	15	2	£14,620.00	£18,020.00	£3,400.00	£1,700.00
31	32	14	10	4	£3,220.00	£6,440.00	£3,220.00	£805.00
32	43	13	10	3	£8,580.00	£11,180.00	£2,600.00	£866.67
39	42	25	21	4	£13,625.00	£26,500.00	£12,875.00	£3,218.75
42	43	18	15	3	£14,940.00	£19,080.00	£4,140.00	£1,380.00
46	47	11	9	2	£6,930.00	£10,395.00	£3,465.00	£1,732.50
50	52	9	7	2	£5,400.00	£7,470.00	£2,070.00	£1,035.00
Projected Crashed Days				23	Projected Crashed Costs		£34,070.00	
Projected Crashed Days - Critical Path				14	Projected Daily Crashed Costs (23 Days)			£1,481.30

Table 3 - Project Crash Costing Schedule

As shown in the table above, identified task and activities that are both on and off the critical path, have been crashed costed in order to reduce the project timeline. By allocating additional resources to these tasks and activities, as shown in appendix 11.6., the timeline can be reduced by 23 working days. However given timeline reductions must not incur any alterations to the critical path, in reality to achieve this, the overall timeline can only be reduced by a total of 14 days, as illustrated in the image below.

The additional resource required for crash costing these tasks and activities will increase the overall project cost by an estimated £34,070.00; a projected overspend of 7.5% from the allocated budget of £450,000.00. The daily estimate of crash costing the project for a total reduction of 23 working days is projected to be £1,481.30.

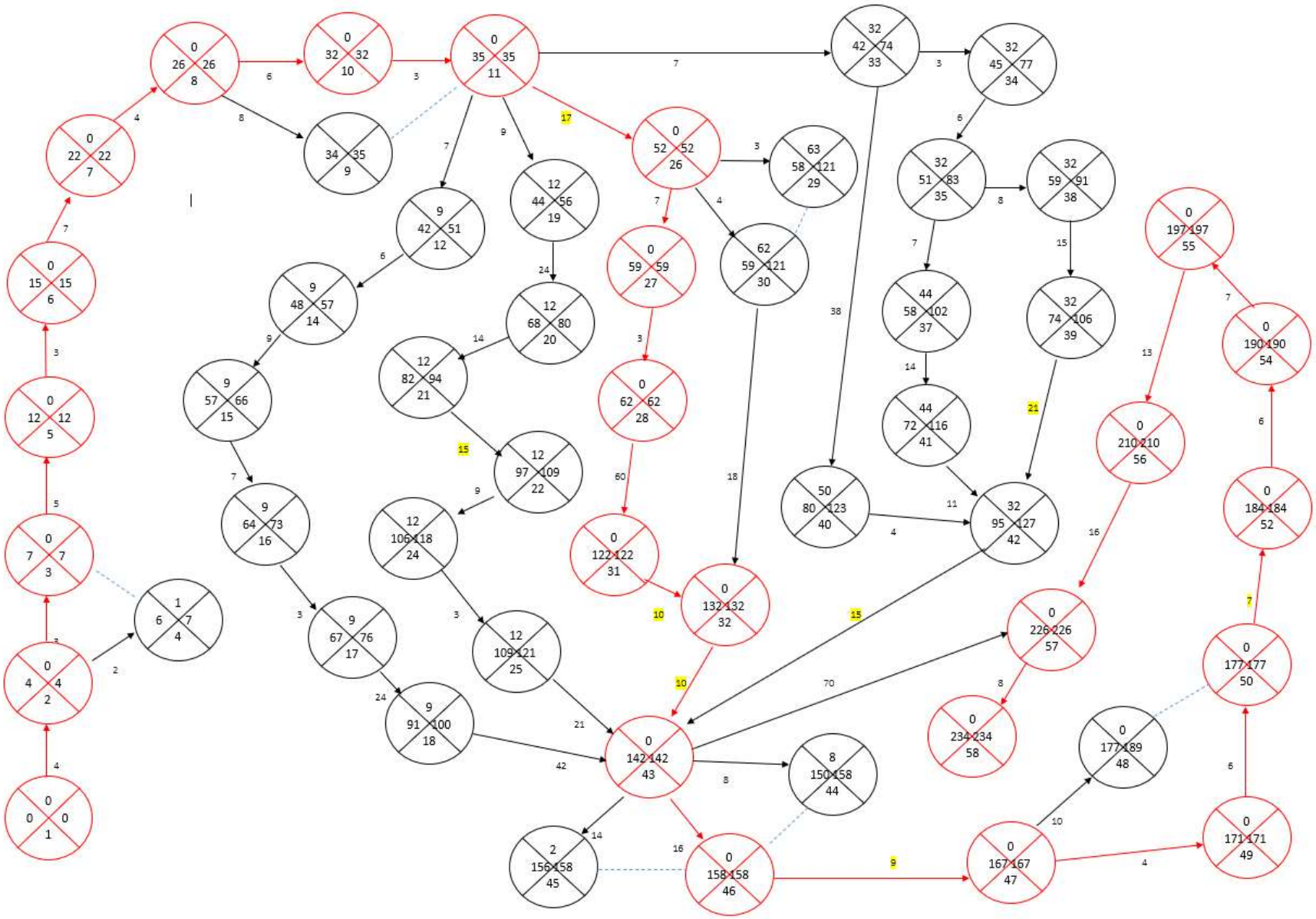

Figure 9 - Crashed Network Diagram

8. Project Handover Consideration

Project handover, is a crucial phase in project management, marking the transition of a completed project from the project team to the client. Project handover, involving transfer of project deliverables, documentation, knowledge, and responsibilities, is essential to minimise disruptions, ensure stakeholder satisfaction, and facilitate long-term success. A comprehensive handover plan must be established early in the project lifecycle, outlining key activities, timelines, and responsibilities associated with the handover, serving as a roadmap, guiding the team through the transition (APM, 2017).

Effective communication and documentation are a cornerstone of a successful project handover. Regular updates and status reports help manage expectations, whilst administering shared understanding of project objectives. The project team are required to conduct a thorough review of all project deliverables, ensuring required objectives and quality standards are met. Identified defects or issues must be addressed and prior to handover. All project-related documents such as, plans, technical specifications and user manuals must be organised and updated prior to handover (APM, 2017).

During the final execution and closing of the project, a period of post-implementation support is accounted for within the project plan. This is a dedicated period for the project team to provide any required support and guidance required by the stakeholders. As stakeholders will be kept informed, engaged and trained for the required objectives during the lifespan of the project, it is anticipated that this period will be used to predominantly audit the 1P1L system in operation and to allow the project team to finalise any knowledge transfer. All project documentation, policies and process flows will be placed onto company shared access servers for all stakeholders to access in future.

9. Conclusion

Utilising established and proven project management techniques forms the cornerstone to the success of any organisation's planning and execution of a project, especially so in the case of those with significant impact on operations such as the 1P1L project in Tata Steel. The benefits to such an approach are widely reported, incorporation of many of the techniques into the local project having demonstrated this, and provided an increased visibility over the project as a whole.

1P1L has been proposed in an attempt to implement improved safeguards in process that carry significant risk to both personnel and the organisation, and therefore the stakes around delivery are particularly high. By employing scrupulous planning and adequate resource, project managers can begin to unravel the complexities of the project, highlight and therefore mitigate potential risks, and identify critical paths to achieve project outcomes. Maintaining effective communication is not only needed to secure stakeholder engagement, but is also a crucial part of project management, and is in fact integral to the successful application of many tools and techniques.

Applying the various project management techniques to the 1P1L project has provided a systematic approach to determination of the project timeline, budget suitability and risk management, allowing confidence over project delivery and realisation. The use of various visualisation techniques such as the Network diagram, Gantt chart and PERT analysis has enabled formulation of an activity and task plan for the project that offers a realistic timeframe for delivery within the £450,000 budget, whilst ensuring all critical steps are attained, potential risks are accounted for, and quality not compromised. The ability to apply a pragmatic crash costing approach has also offered a reasoned, calculated approach for presenting potential options for, and costs associated with, reducing the projected timeline should the situation arise, again without compromising the critical path of the project.

Not only offering a robust implementation plan for 1P1L, but the ability also to take the knowledge and experience gained of project management techniques forward, and apply such techniques across future projects will support the organisation in its desire to maintain continuous improvement amidst a drive for growth and sustainability, and achieve organisational objectives.

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11. Appendix

11.1. Activity Schedule

Activity Schedule			Duration (Days)
1		Develop detailed scope of work	4
2	•	Sign off scope of work	3
3		Develop project plan	5
4		Select & pull together team	2
5	•	Confirm financial arrangements	5
6		Develop initial comms	3
7		Deliver comms sessions	7
8		Develop Trostre policy for 1P1L	4
9		Consultation period & peer review for policy	10
10		Failure testing system (hypothetical)	6
11	•	Sign off	3
12		Develop training	9
13		Review central training	3
14		Review Trostre existing training requiring updates.	6
15		Trial training/ develop/ Include FAQs	9
16		Failure testing system (practical)	4
17	•	Sign off training	3
18		Deploy training	24
19		Complete operational area isolation point reviews	9
20		Plan & complete improvement work for lock points in operational areas.	24
21		Complete area 4 isolation standards reviews	14
22		Plan & complete improvement work for lock points, schedules and P&IDs in A4.	17
23		Register non-compliant isolation points.	5
24		Develop risk assessment method for non-lockable points.	9
25		Complete risk assessments for WE sign off.	3
26		Procurement of required equipment	20
27		Complete local audits for lines and areas of required equipment.	7
28		Order equipment	3
29		Generate central register for PIE, names, BOs	3
30		Generate order for ID tags using central register	4
31	•	Delivery of Equipment	60
32		Distribute PIE & register individuals	14
33		Permit offices	7
34		Scope areas for applicable spaces.	3
35		Identify areas requiring alternative office solutions	6
36		Generate solutions	4
37		Order alternative solutions	7
38		Design standard permit office and board layout	8
39		Consult local teams on design standard	15
40		Modify existing permit offices	38

41		Set up alternative solutions	14
42		Deliver & set up lockout equipment (Phased plan)	25
43	•	Run trials on key units	18
44		Failure testing system (practical)	8
45		Complete required builds	14
46	•	Prepare final deployment plan	6
47		Interface with affected policy owners & committees	11
48		Manage changes required for 1P1L	10
49		Develop management system for 1P1L system.	4
50		Develop standard auditing process	4
51		Develop templates	6
52		Sign off Management System	3
53		Complete management of change	4
54	•	Sign off management of change	2
55	•	Sign off final roll out (Final gate)	7
56	•	Execute roll out	13
57		Support & auditing period	70
58		Complete final report on recommendations for full compliance.	8

Table 4 - Activity Schedule

Activity Schedule		Duration (Days)	Activity Schedule		Duration (Days)
1	2	4	11	33	7
2	3	3	33	34	3
2	4	2	34	35	6
3	5	5	35	37	8
5	6	3	35	38	8
6	7	7	38	39	15
7	8	4	39	42	25
8	9	8	37	41	14
8	10	6	41	42	11
10	11	3	33	40	38
11	12	7	40	42	4
12	14	6	18	43	42
14	15	9	25	43	21
15	16	4	32	43	13
16	17	3	42	43	18
17	18	24	43	44	8
11	19	9	43	45	14
19	20	24	43	46	16
20	21	14	46	47	11
21	22	17	47	48	10
22	24	9	47	49	4
24	25	3	49	50	6
11	26	20	50	52	9
26	27	7	52	54	6
27	28	3	54	55	7
27	29	3	55	56	13
27	30	4	56	57	16
30	32	14	43	57	70
28	31	60	57	58	6
31	32	14			

Table 5 - Network Diagram Activity Schedule

11.2. Network Diagram

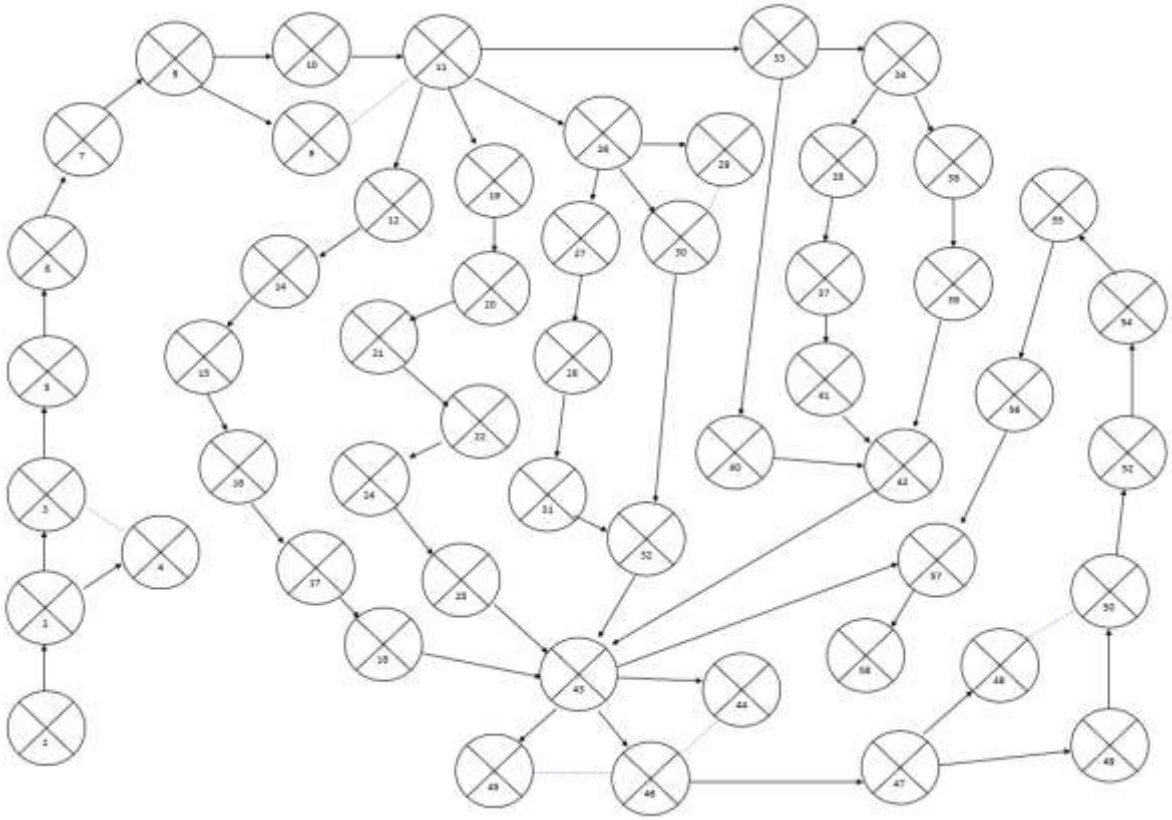

Figure 10 - Network Diagram Stage 1

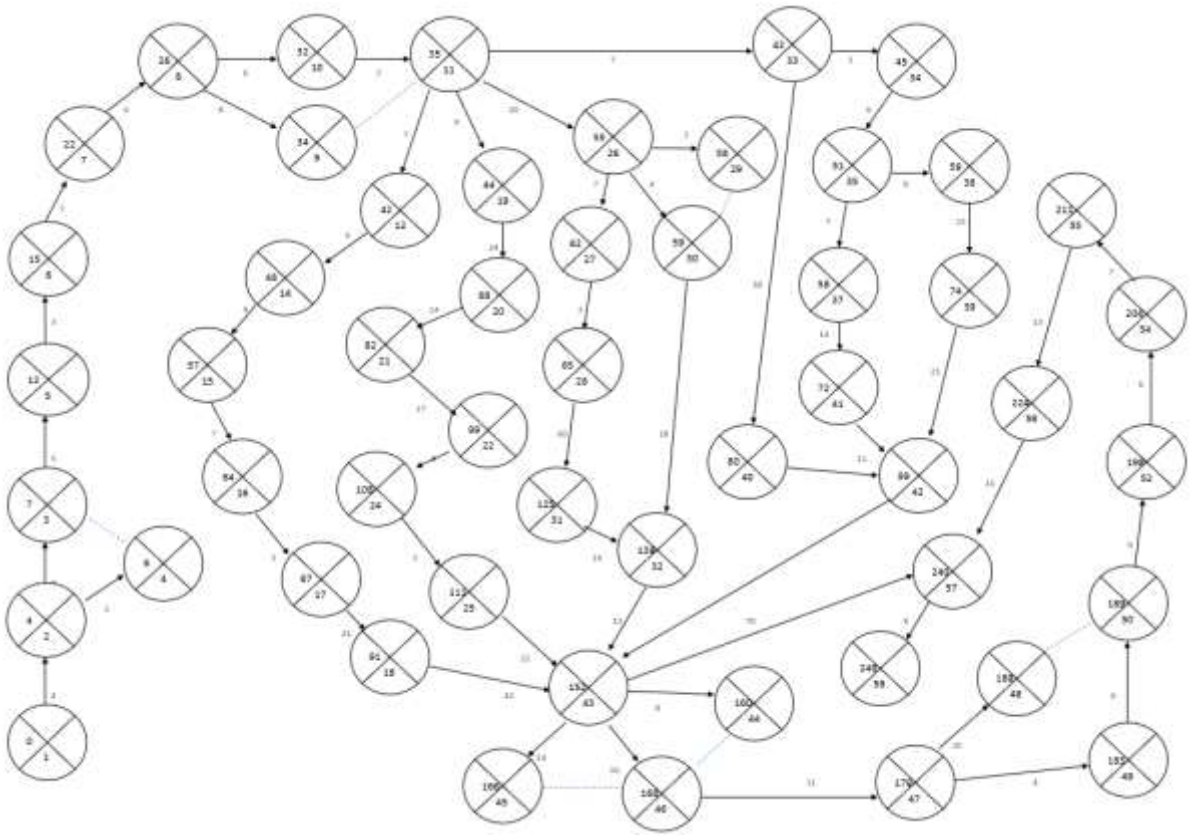

Figure 11 - Network Diagram Stage 2

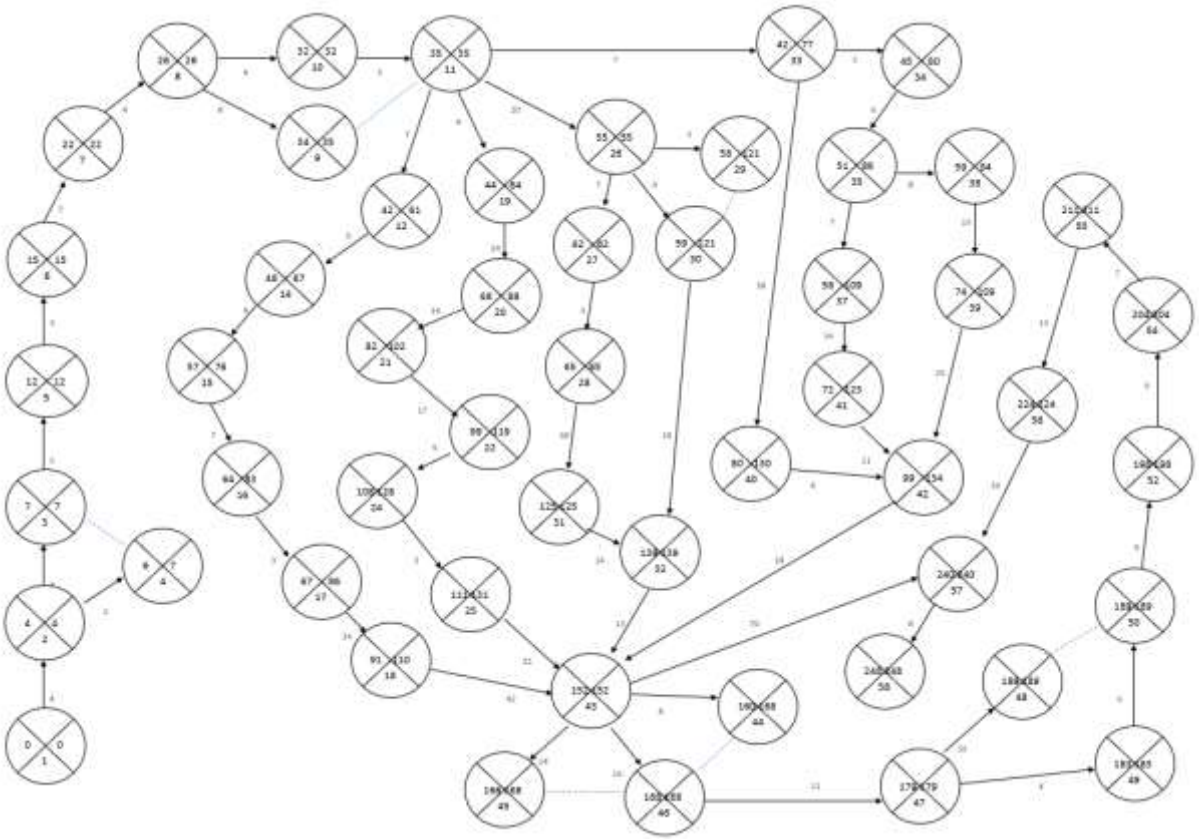

Figure 12 - Network Diagram Stage 3

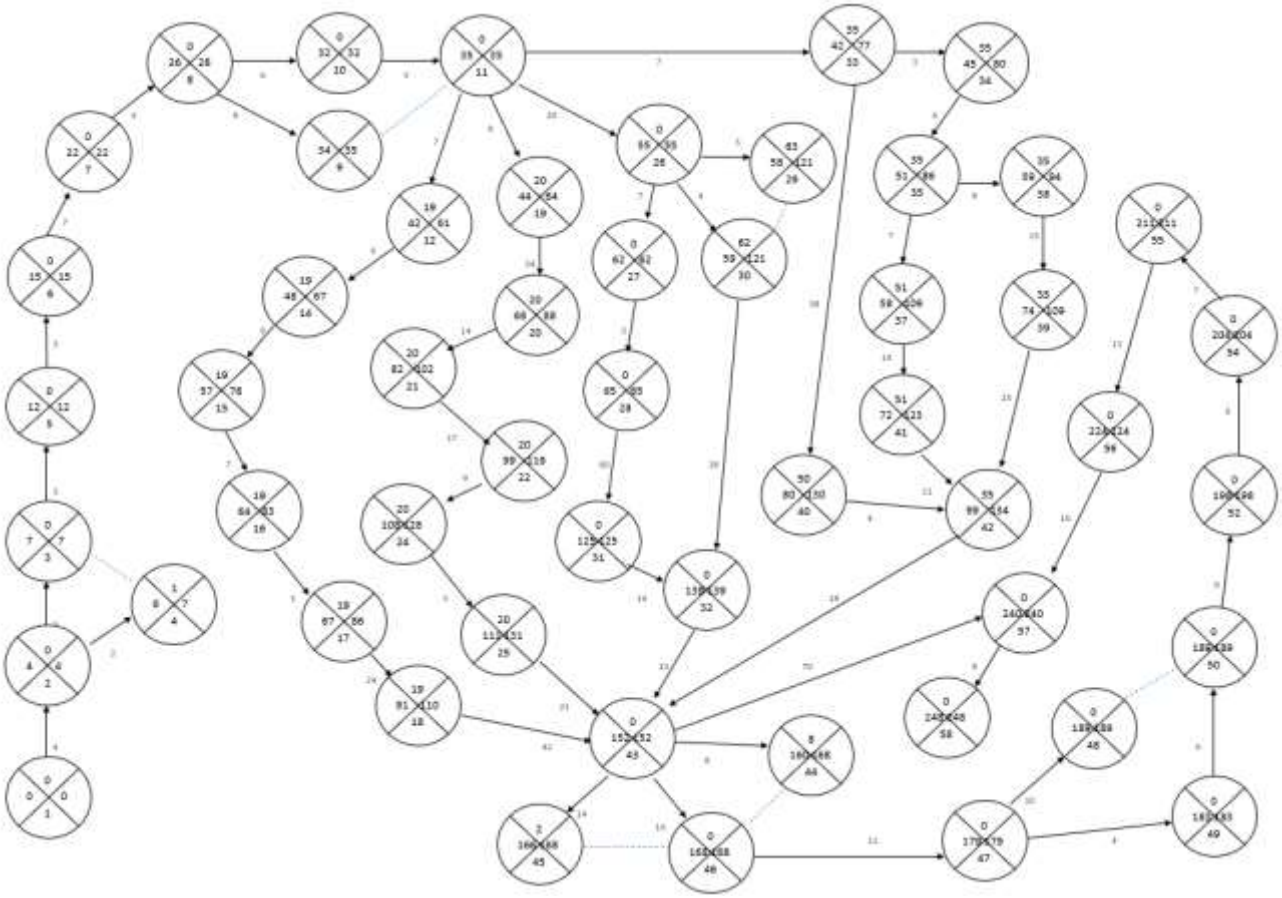

Figure 13 - Network Diagram Stage 4

11.3. Gantt Chart

Project Planner - Trostre's 1 Person 1 Lock System

Year :2024

Period Highlight: % Complete | Actual (beyond plan) | % Complete (beyond plan)

	ACTIVITY ♦ = Key Milestone	PLAN START WEEK	PLAN DURATION WEEK	ACTUAL START WEEK	ACTUAL DURATION WEEKS	PERCENT COMPLETE
1	Develop detailed scope of work	14	1			0%
2	♦ Sign off scope of work	15	1			0%
3	Develop project plan	15	1			0%
4	Select & pull together team	16	1			0%
5	♦ Confirm financial arrangements	16	1			0%
6	Develop initial comms	17	1			0%
7	Deliver comms sessions	18	2			0%
8	Develop Trostre policy for 1P1L	20	2			0%
9	Consultation period & peer review for policy	19	1			0%
10	Failure testing system (hypothetical)	20	1			0%
11	♦ Sign off	20	2			0%
12	Develop training	21	2			0%
13	Review central training	21	2			0%
14	Review Trostre existing training requiring updates.	22	2			0%
15	Trial training/ develop/ Include FAQs	24	1			0%
16	Failure testing system (practical)	25	1			0%
17	♦ Sign off training	25	5			0%
18	Deploy training	30	9			0%
19	Complete operational area isolation point reviews	22	2			0%
20	Plan & complete improvement work for lock points in operational areas.	23	5			0%
21	Complete area 4 isolation standards reviews	27	3			0%
22	Plan & complete improvement work for lock points, schedules and P&IDs in A4.	30	3			0%
23	Register non compliant isolation points.	33	2			0%
24	Develop risk assessment method for non lockable points.	35	1			0%
25	Complete risk assessments for WE sign off.	36	1			0%
26	Procurement of required equipment	20	5			0%
27	Complete local audits for lines and areas of required equipment.	25	2			0%
28	Order equipment	27	1			0%
29	Generate central register for PIE, names, BOs	27	1			0%
30	Generate order for ID tags using central register	28	1			0%
31	♦ Delivery of Equipment	27	10			0%
32	Distribute PIE & register individuals	37	3			0%
33	Permit offices	20	8			0%
34	Scope areas for applicable spaces.	21	2			0%
35	Identify areas requiring alternative office solutions	22	2			0%
36	Generate solutions	23	2			0%
37	Order alternative solutions	23	2			0%
38	Design standard permit office and board layout	25	3			0%
39	Consult local teams on design standard	28	5			0%
40	Modify existing permit offices	31	1			0%
41	Set up alternative solutions	31	2			0%
42	Deliver & set up lockout equipment (Phased plan)	30	2			0%
43	♦ Run trials on key units	40	3			0%
44	Failure testing system (practical)	43	2			0%
45	Complete required builds	43	2			0%
46	♦ Prepare final deployment plan	43	3			0%
47	Interface with affected policy owners & committees	46	2			0%
48	Manage changes required for 1P1L	48	3			0%
49	Develop management system for 1P1L system.	1	2			0%
50	Develop standard auditing process	2	2			0%
51	Develop templates	2	2			0%
52	Sign off Management System	3	3			0%
53	Complete management of change	3	3			0%
54	♦ Sign off management of change	5	2			0%
55	♦ Sign off final roll out (Final gate)	6	2			0%
56	♦ Execute roll out	7	3			0%
57	Support & auditing period	43	15			0%
58	♦ Complete final report on recommendations for full compliance.	10	2			0%

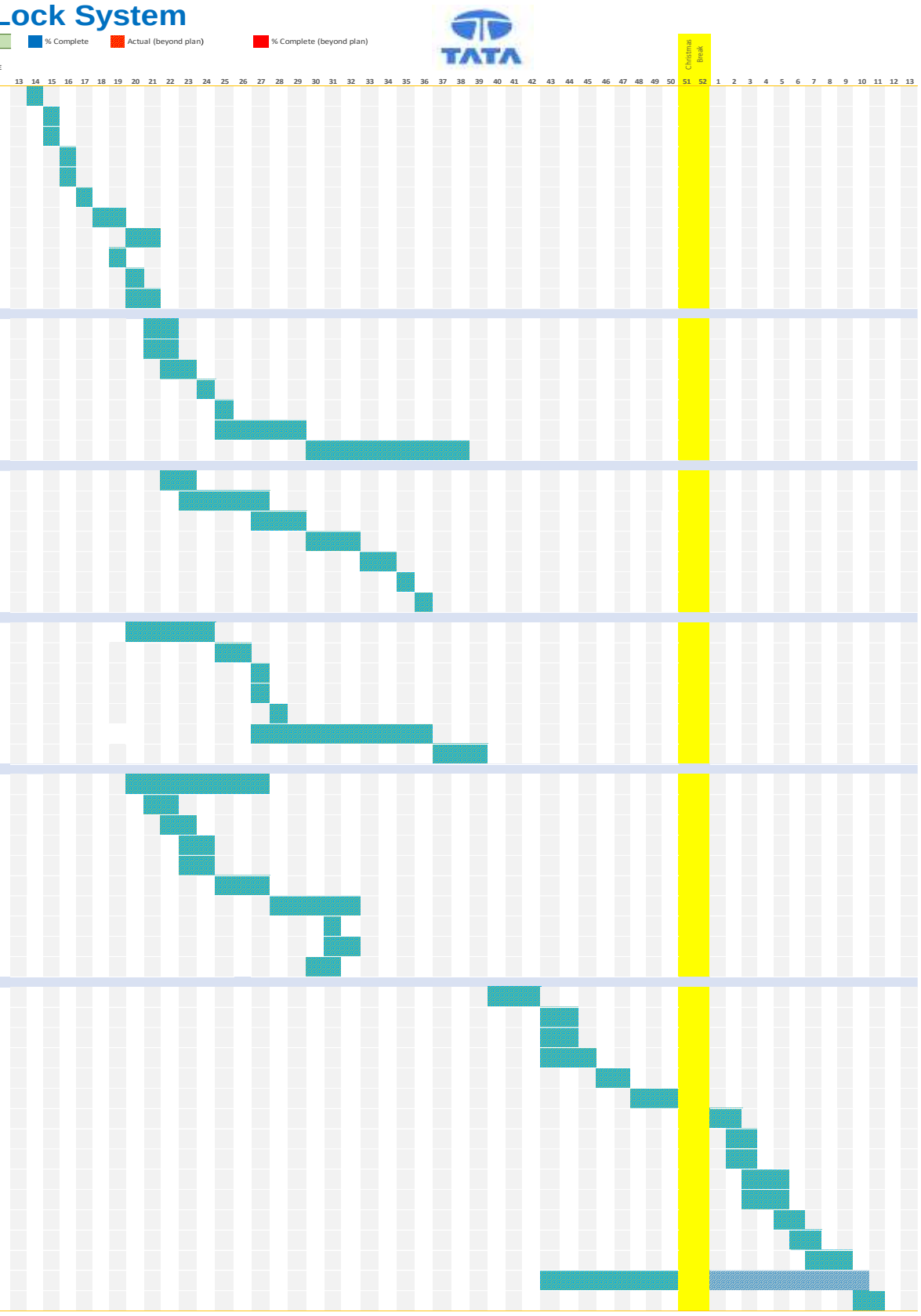

Figure 14 - Gantt Chart

11.4. Project Risk Management

Impact \ Likelihood	Very unlikely to happen	Unlikely to happen	Possibly could happen	Likely to happen	Very likely to happen
Catastrophic consequences	Moderate	Moderate	High	Critical	Critical
Significant consequences	Low	Moderate	Moderate	High	Critical
Moderate consequences	Low	Moderate	Moderate	Moderate	High
Low consequences	Very Low	Low	Moderate	Moderate	Moderate
Negligible consequences	Very Low	Very Low	Low	Low	Moderate

Figure 15 - Project Risk Matrix

(Sienkiewicz, 2022)

Risk Field	Group of risks related to the topic
Legislation	Cause related to legal and regulatory framework; in order to obtain a licence to operate including in regard to environmental impact.
Technical	Cause related to the technical scope. (e.g. design, constructability, interfaces)
Organisational	Cause related to roles and responsibilities, organisational structure, stakeholders, culture.
Operational	Cause related to operational items. (e.g. planning, resources)

Table 6 - Project Risk Register Risk Field

Risk field table, used to identify risk field for register.

Response on risk	
Avoid Threat	Take action to remove risk
Reduce Threat	Take mitigation measures to change impact or probability
Transfer the risk	Transfer the risk to a third party
Share risk	Share risk by encouraging collaboration

Table 7 - Project Risk Register Risk Response

Risk response table, used to allocate appropriate responses for identified project risks.

Risk IdentificationA3:U15						Risk Analysis				Risk Evaluation			Risk Treatment						
Identification			Description																
Risk-ID	Risk Title	Risk Field	Cause	Effect	Phase/level of possible occurrence	Likelihood	Impact	*Consequence*	Priority	Impact If Risk Occurs	Risk Response	Risk Owner	Risk Treatment (Risk response measures)	Residual risk after response has been implemented	Date last update	Risk Status	Forecast expiry date	Addressed by	Cost involved
1	Project purpose	Legislation	Project is not well defined lacking deliverables	Programme delays	EXEC	1	4	3	Low	Moderate	Avoid	Project Manager	Good communication between all stakeholders						
2	Planning	Organisational	Changes to the plan	Delays in completion	EXEC	1	4	3	Low	Moderate	Reduce	Project Manager	Good communication between all stakeholders. Monitor and review progress.						
3	Develop Site policy	Organisational	Site policy for 1P1L implementation insufficient	Delays in implementation and completion	EXEC	1	4	4	Low	High	Share	Project Manager	Good communication between all stakeholders. Consultation and peer reviews						
4	Develop Training	Organisational	Training for 1P1L is insufficient.	Delays in implementation and completion	Project	1	4	4	Low	High	Share	Project Manager	Good communication between all stakeholders. Consultation and review Tata central training material. Failure test training package						
5	Order Placement	Organisational	Unable to timely place orders. Delivery delays	Programme delays	EXEC	3	5	5	High	Critaical	Avoid	Project Manager	Communicate with suppliers. Place orders in advance to ensure timely delivery						
6	Procurement	Organisational	Insufficient procurement resources to support the project	Programme delays	Project	2	4	5	Moderate	Critaical	Share	Project Manager	Communicate with stakeholders. Ensure that sufficient time is allowed for purchasing to support						
7	Engineering Resource	Organisational	Insufficient engineering resources to support the project	Delays in information flow / approvals to contractor	Operations	2	5	5	Moderate	Critaical	Share	Project Manager	Communicate with team members, ensure they are all aware of their requirements.						
8	Labour availability	Organisational	Lack of available qualified and trained labour	Delay in installation / commissioning work	EXEC	2	3	3	Moderate	High	Avoid	Project Manager	Communicate with contractors. Ensure that they are all aware of their requirements						
9	Works access	Operational	The volume of work to be done in a restricted location presents logistical issues.	Delays in installation phase	Project	2	4	4	Moderate	High	Share	Project Manager	Good communications between all stakeholders						
10	Improvement work for lock points in operational areas.	Operational	Insufficient engineering resources to support the project	Programme delays	Project	1	4	4	Low	High	Share	Project Manager	Communicate with stakeholders. Ensure that sufficient time is allowed for work to be undertaken. Seek support from A4 if required						
11	Complete A4 Isolation Review	Operational	Insufficient engineering resources to support the project	Programme delays	Project	1	3	3	Low	Moderate	Share	Project Manager	Communicate with stakeholder and project team,						
12	Trials on Key units	Operational	Unsuccessful trials. Due to confusion of new working methods and changes to existing system	Delays in completion	Operations	2	3	4	Moderate	Moderate	Reduce	Project Manager	Good communication between all stakeholders. Consultation and peer reviews						
13	Final deployment plan	Operational	Unsuccessful trials.	Delays in completion	Project	1	4	5	Low	Critaical	Reduce	Project Manager	Communicate with stakeholder and project team, Monitor and review						
14	Insufficient trials/Test Runs	Technical	Lack of Time/Resource	Project delays	Operations	2	4	2	Low	Moderate	Share	Project Manager	Communicate with stakeholder and project team, Monitor and review						
15	Management of Change	Operational	Project delays or technical issues	Project delays	EXEC	2	3	3	Moderate	Moderate	Reduce	Project Manager	Good communications between all stakeholders.						
16	Final roll out	Technical	Delays in project and poor support	Project delays	EXEC	2	3	3	Moderate	Moderate	Share	Project Manager	Communicate with stakeholder and project team, Monitor and review						
17	Support and Auditing	Technical	Delays in project and poor support	Project delays	EXEC	1	3	4	Low	Moderate	Transfer	Project Manager	Communicate with stakeholder and project team, Monitor and review						

Table 8 - Project Risk Register

11.5. Project Costing

Activity		Activity Duration (Days)	£115 - Day - Worker	£165 - Day - Contractor	£200 - Day - Manager/Supervisor	Activity Cost	Activity		Activity Duration (Days)	£115 - Day - Worker	£165 - Day - Contractor	£200 - Day - Manager/Supervisor	Activity Cost
1	2	4	0	0	1	£800.00	11	33	7	0	0	2	£2,800.00
2	3	3	0	0	1	£600.00	33	34	3	3	3	1	£3,120.00
2	4	2	0	0	2	£800.00	34	35	6	4	3	1	£6,930.00
3	5	5	0	0	2	£2,000.00	35	37	8	4	3	1	£9,240.00
5	6	3	0	0	1	£600.00	35	38	8	4	3	1	£9,240.00
6	7	7	0	0	2	£2,800.00	38	39	15	4	0	1	£9,900.00
7	8	4	2	0	2	£2,520.00	39	42	25	3	0	1	£13,625.00
8	9	8	0	0	2	£3,200.00	37	41	14	2	3	0	£10,150.00
8	10	6	0	0	2	£2,400.00	41	42	11	4	3	1	£12,705.00
10	11	3	2	0	2	£1,890.00	33	40	38	3	3	1	£39,520.00
11	12	7	0	0	2	£2,800.00	40	42	4	4	3	1	£4,620.00
12	14	6	2	0	2	£3,780.00	18	43	42	0	0	1	£8,400.00
14	15	9	2	0	2	£5,670.00	25	43	21	0	0	2	£8,400.00
15	16	4	3	0	1	£2,180.00	32	43	13	4	0	1	£8,580.00
16	17	3	3	0	1	£1,635.00	42	43	18	2	0	3	£14,940.00
17	18	24	0	0	2	£9,600.00	43	44	8	4	0	4	£10,080.00
11	19	9	0	0	2	£3,600.00	43	45	14	2	3	1	£12,950.00
19	20	24	4	0	0	£11,040.00	43	46	16	2	0	2	£10,080.00
20	21	14	2	0	2	£8,820.00	46	47	11	2	0	2	£6,930.00
21	22	17	4	0	2	£14,620.00	47	48	10	0	0	2	£4,000.00
22	24	9	4	0	1	£5,940.00	47	49	4	2	0	4	£4,120.00
24	25	3	0	0	2	£1,200.00	49	50	6	0	0	2	£2,400.00
11	26	20	0	0	2	£8,000.00	50	52	9	0	0	3	£5,400.00
26	27	7	2	3	2	£7,875.00	52	54	6	0	0	3	£3,600.00
27	28	3	4	0	1	£1,980.00	54	55	7	0	0	2	£2,800.00
27	29	3	4	0	1	£1,980.00	55	56	13	4	0	4	£16,380.00
27	30	4	4	0	1	£2,640.00	56	57	16	4	0	4	£20,160.00
30	32	14	4	0	2	£12,040.00	43	57	70	2	0	2	£44,100.00
28	31	60	0	0	1	£12,000.00	57	58	6	2	0	4	£6,180.00
31	32	14	2	0	0	£3,220.00	Project Cost					£449,580.00	

Table 9 - Project Costing

11.6. Crash Costing.

Activity		Activity Duration (Days)	£115 - Day - Worker	£165 - Day - Contractor	£200 - Day - Manager/Supervisor	Activity Cost	Activity		Activity Duration (Days)	£115 - Day - Worker	£165 - Day - Contractor	£200 - Day - Manager/Supervisor	Activity Cost
1	2	4	0	0	1	£800.00	11	33	7	0	0	2	£2,800.00
2	3	3	0	0	1	£600.00	33	34	3	3	3	1	£3,120.00
2	4	2	0	0	2	£800.00	34	35	6	4	3	1	£6,930.00
3	5	5	0	0	2	£2,000.00	35	37	8	4	3	1	£9,240.00
5	6	3	0	0	1	£600.00	35	38	8	4	3	1	£9,240.00
6	7	7	0	0	2	£2,800.00	38	39	15	4	0	1	£9,900.00
7	8	4	2	0	2	£2,520.00	39	42	25	4	0	3	£26,500.00
8	9	8	0	0	2	£3,200.00	37	41	14	2	3	0	£10,150.00
8	10	6	0	0	2	£2,400.00	41	42	11	4	3	1	£12,705.00
10	11	3	2	0	2	£1,890.00	33	40	38	3	3	1	£39,520.00
11	12	7	0	0	2	£2,800.00	40	42	4	4	3	1	£4,620.00
12	14	6	2	0	2	£3,780.00	18	43	42	0	0	1	£8,400.00
14	15	9	2	0	2	£5,670.00	25	43	21	0	0	2	£8,400.00
15	16	4	3	0	1	£2,180.00	32	43	13	4	0	2	£11,180.00
16	17	3	3	0	1	£1,635.00	42	43	18	4	0	3	£19,080.00
17	18	24	0	0	2	£9,600.00	43	44	8	4	0	4	£10,080.00
11	19	9	0	0	2	£3,600.00	43	45	14	2	3	1	£12,950.00
19	20	24	4	0	0	£11,040.00	43	46	16	2	0	2	£10,080.00
20	21	14	2	0	2	£8,820.00	46	47	11	3	0	3	£10,395.00
21	22	17	4	0	3	£18,020.00	47	48	10	0	0	2	£4,000.00
22	24	9	4	0	1	£5,940.00	47	49	4	2	0	4	£4,120.00
24	25	3	0	0	2	£1,200.00	49	50	6	0	0	2	£2,400.00
11	26	20	1	0	2	£10,300.00	50	52	9	2	0	3	£7,470.00
26	27	7	2	3	2	£7,875.00	52	54	6	0	0	3	£3,600.00
27	28	3	4	0	1	£1,980.00	54	55	7	0	0	2	£2,800.00
27	29	3	4	0	1	£1,980.00	55	56	13	4	0	4	£16,380.00
27	30	4	4	0	1	£2,640.00	56	57	16	4	0	4	£20,160.00
30	32	14	4	0	2	£12,040.00	43	57	70	2	0	2	£44,100.00
28	31	60	0	0	1	£12,000.00	57	58	6	2	0	4	£6,180.00
31	32	14	4	0	0	£6,440.00	Project Cost					£483,650.00	

Table 10 - Project Crash Costing