Changing a national railway's engineering approach to Safety – doing it the Lean Manufacturing way

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1 SUMMARY

The experience of the Irish Rail engineering teams is that the effectiveness of a new Safety Management System (SMS) to improve Safety performance is significantly dependent on the nature of the prevailing organisational culture, current behaviours and the robustness of the new SMS processes. While a robust SMS can be designed with relative ease, a broader change programme may be required to establish those processes and methods that will cultivate and drive those new behaviours that will, in time, become the new organisational culture. Changing Irish Rail engineering's approach to Safety required both of these – a new and robust Safety Management System as well as a significant change programme. The changes are discussed in this paper and have delivered a 69% reduction in Occupational Safety lost time accidents and a similarly significant reduction, 60% qualitatively, in Asset Safety risk.

In order to be robust, a SMS must specify individual accountabilities unambiguously, ensure that the leadership have hands-on Safety roles, use simple and standardised safety processes, have robust information feedback per safety process and must have a simple mechanism to make the SMS and its safety processes accessible to employees. In developing a new Safety Management System, the use of Lean Manufacturing principles such as Control Rooms, visual controls, control point standardisation, root cause analysis, practical problem solving and closed-loop processes can contribute significantly to the robustness, simplicity and effectiveness of that SMS.

2 INTRODUCTION

A series of engineering Safety incidents, culminating in an Irish Rail viaduct collapsing in 2009, indicated that Irish Rail's engineering management of Asset Safety and Occupational Safety required urgent revision. The two most significant root causes for the prevailing approach to Safety were identified as the lack of systemised safety management and a traditional, "informal" Safety culture where Safety was considered the responsibility and agenda of the safety professionals. Whilst line managers and employees all considered Safety as important, individuals and teams did not behave in ways that reflected the importance or the practices of Safety.

During the same period conflicting business demands had to be delivered - significant budget reductions had to be achieved at a time when improved risk management required an increase in workload per year. Irish Rail's three engineering disciplines (Civil Engineering & Permanent Way, Mechanical Engineering & Fleets, Signalling Electrification & Telecommunications) had to change their organisational structures, systems, processes and behaviours to meet cost, quality and customer satisfaction targets whilst also improving Safety performance at the same time.

The improvements in Safety performance was achieved through the introduction of a new Safety Management System, supported by a broader change programme focussing on changing behaviours, processes and methods.

3 "SAFETY IS DETERMINED BY YOUR OPERATION, NOT YOUR SAFETY PROFESSIONALS"

While this paragraph title appears to be an obvious statement, the impact of the prevailing organisational culture on Safety performance can be underestimated. Organisational cultures can drift and migrate to a position where the Safety professionals in the business become the main activists and protagonists for Safety. The side effects of such a drift in culture includes behavioural changes in line management that marginalises Safety – e.g. Safety is perceived as an impediment to "getting the job done", a distraction from the daily priorities and the "agenda" of the Safety professionals. Trying to improve Safety performance in such an environment without addressing the cultural issues first is difficult, costly and slow. In such organisations Safety is often not the only business performance indicator that is lagging, normally several other performance indicators such as customer focus, quality, production outputs, timely programmes and cost would also be struggling. More often than not, any business improvement requires a root-and-branch review of all the aspects of the business and all its operations – including the business strategy, organisation, structure, management methods, planning systems, performance management principles, operational control, processes and, of course, the safety and quality management.

The business model for any railway is substantially based on customers having a positive impression and a positive experience of that railway's Safety performance. Rail customers that have the means and that can avoid travelling on a railway do exactly that when that railway is perceived as unsafe. The trend in engineering related Safety incidents in Irish Rail indicated that, over several years, despite a very strong company awareness of the importance of Safety and good engineering competence, engineering outputs posed Safety risks. The incident that best captures this dichotomy was the collapse of a viaduct (Broadmeadow viaduct at Malahide) in August 2009. While no-one was injured in this incident, only a slight variation in events could have resulted in multiple fatalities. At the time and leading up to 2009, the same underlying root cause, namely ineffectual asset maintenance practices, was prevalent in the other engineering disciplines but had been rectified in the Mechanical Engineering & Fleets discipline by 2008.

In the three Irish Rail engineering disciplines, in-depth reviews of all the operations per engineering discipline by the Chief Engineer & Deputy CEO led to comprehensive change programmes in 2007 (Mechanical Engineering & Fleets) and 2010 (Civil Engineering & Permanent Way and Signalling Electrification & Telecommunications). After defining the new business direction and clear strategic objectives per engineering discipline, 5-year business plans with substance and realistic intermediate milestones were established. An organisational design that is capable of achieving the new strategic direction was widely communicated and the new organisation in each engineering discipline was populated with leadership candidates that understood and exhibited the management behaviours required to deliver the strategy. The four core principles of the new strategy in each engineering discipline, namely "high operational control, high standardisation, high compliance, low waste", are aligned around a strong customer service focus. Implicitly, improved Safety, improved quality, improved costs and improved output performance are the required business outputs, while the four core principles are the levers that deliver these outputs through new processes and new systems. The most significant new systems were the implementation of a new Safety Management System (SMS) and a new Quality Management System (QMS) per engineering discipline.

In the next paragraphs the structure and content of the new engineering Safety Management Systems is discussed. Throughout these discussions it is evident that Safety performance, whether in Occupational Safety or Asset Safety performance, could not be improved in isolation and that significant further change in the broader management of the engineering disciplines were required. Without these broader changes to processes and systems, the improvement of Safety performance was not possible. However, underpinning all of the changes was the firm objective to re-establish Safety as the accountability of the line managers. Through the deployment of the SMS and the changes to processes and systems, the "ownership" for Safety was systematically migrated to line managers while Safety professionals were re-directed to support, facilitate and guide the bigger Safety agenda. Thus the heading to this paragraph: "Safety is determined by your operation, not your Safety professionals".

4 THE NEW ENGINEERING SAFETY MANAGEMENT SYSTEMS

The new engineering Safety Management Systems (SMS's) were implemented in compliance with the European Railway Agency (ERA) guidelines for Safety Management Systems and in consultation with the Irish National Safety Authority ("Railway Safety Commission", RSC). Including the National Safety Authority as a partner in all the phases of the development of an SMS is best practice as common methods require cross-organisational understanding and agreement. Changes in the regulation of railways have increased the extent of "supervision" or monitoring by National Safety Authorities and therefore the joint development of an SMS allows for roles and responsibilities of the organisations to be discussed and clarified.

Eight aspects of the new engineering SMS's, as discussed here, are distinctive and are contributing significantly to improve the Safety performance within the Irish Rail engineering disciplines.

4.1 Separated accountabilities for Asset Safety and Occupational Safety

The new engineering SMS's are a significant departure from Irish Rail's traditional safety management approach as it divides the whole railway up into (1) geographic areas of Occupational Safety accountabilities and (2) physical assets with Asset safety accountabilities. Each of the three engineering disciplines has its own SMS and each team within an engineering discipline has a demarcated physical/geographic area (Occupational Safety accountability) and a specifically identified asset base ownership (Asset Safety accountability). As a further significant change, each engineering discipline is further re-structured into two parts, namely "production" and "technical". The Asset Safety accountability for the safe operation of the assets resides with the Technical Manager in each engineering discipline – the Technical Manager Fleets is fully accountable for rolling stock safety while the Technical Manager Civil Engineering is fully accountable for the safety of track, structures, level crossings and embankments. The Technical Managers for each engineering discipline specify technical standards, approve maintenance instructions, change manage the introduction of new assets, manage asset risks and provide safety assurance through compliance verification. On the production side, production line managers are fully accountable for Occupational Safety, production planning and scheduling, managing production teams and for optimising the cost base. In addition, production line managers also have an Asset Safety accountability – to ensure that their teams are technically competent and are doing the tasks competently, correctly and to specification/standard. Despite widely varying degrees of complexity of engineering discipline and type of operations between teams, the Lean principle of standardisation was widely adopted and all three the engineering disciplines have the same organisational structure, method, Safety processes and accountabilities. This standardised approach significantly aided the introduction of the new SMS.

4.2 Strong focus on individual accountabilities and creating new behaviours

The second significant change aimed at changing the behaviour of individuals and teams is that nearly half of the text in each SMS is dedicated to specify exactly what accountabilities are held by each post holder and manager. The exact same accountabilities as is in the SMS are reflected in the individualised Safety Responsibility Statements (SRS's) that are signed by every manager and supervisor, creating a direct alignment between SMS and SRS's. Importantly, the organisational structure of the whole engineering organisation (1850 employees + 350 contractors) was re-aligned and re-structured to ensure that decision chains work effectively and that accountable managers had the resources and autonomy to achieve those accountabilities. Where the previous SMS format was less about accountabilities and more about "who will attend what safety meeting", the new focus on clearly defined accountabilities impacted on and significantly affected behaviours. Ineffectual standards are being redrafted and ineffective maintenance practices are actively debated within the engineering disciplines - "It is my responsibility to ensure this Level Crossing is safe, the vegetation cut back for sight-lines as done by your production team is not effective, please do it again following this new standard" would be an example. The result? We now have data, updated every week, detailing and tracking all level crossing works and the extent of compliance and/or mitigations. The tenor and type of the ownership and accountability debates that take place within teams today was unheard of before. This type of change brings its own dynamic for improved quality of work on the ground – and supports the broader business objective to improve quality and costs in the engineering teams.

4.3 Written as an instruction, without "waffle"

The new SMS in each of the engineering disciplines consists of an umbrella Safety Management System document (SMS-001) that describes the framework approach to Safety. This includes eight safety management areas, namely contractor management, safe driving-for-work (i.e. road vehicles), competency management and training, briefings, accident and incident investigations, hazards and risk assessments (including risk management), safety tours and compliance verification and procurement of safety critical equipment. Each of these areas of safety management is described in a supporting SMS standard that is written in a succinct, "how to do it" guide format that details exactly what process to follow, how to complete forms and where to get support from. Where standards can sometimes be vague and full of unnecessary information, these SMS standards are concise to the extent that it reads as an instruction and serves as a training document on the process in question.

4.4 Robust, "closed-loop" processes

The process principle adopted in the design of each of the eight safety management areas was that of a "closed-loop" control process. Each safety management process has a form that clearly states what needs doing and each form captures the management actions taken and as such is retained as a record. This information feedback enables tracking and control to ensure that the safety management actions are actually completed. For example, every hazard reported by an employee is captured on a numbered and standardised Hazard Report Form (centre in Figure 1) that allows for anonymity while also recording, in carbon copy, the management actions to remove or mitigate that hazard (right in Figure 1). The control discipline is reinforced by the accountable line manager signing-off that the "Hazard is closed out". Similar forms are implemented for Risk Assessments, Safety Tours, Briefings, Personal Accident Investigation Reports, Competence Assessments, Road Vehicle inspections, Road Vehicle Accident Investigations and Contractor's permits.

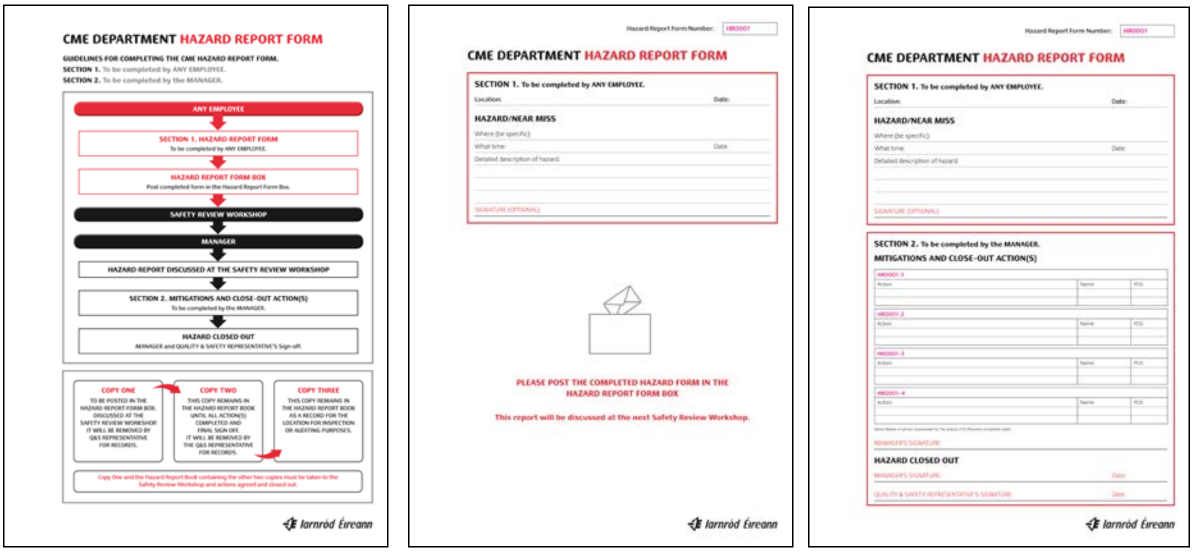


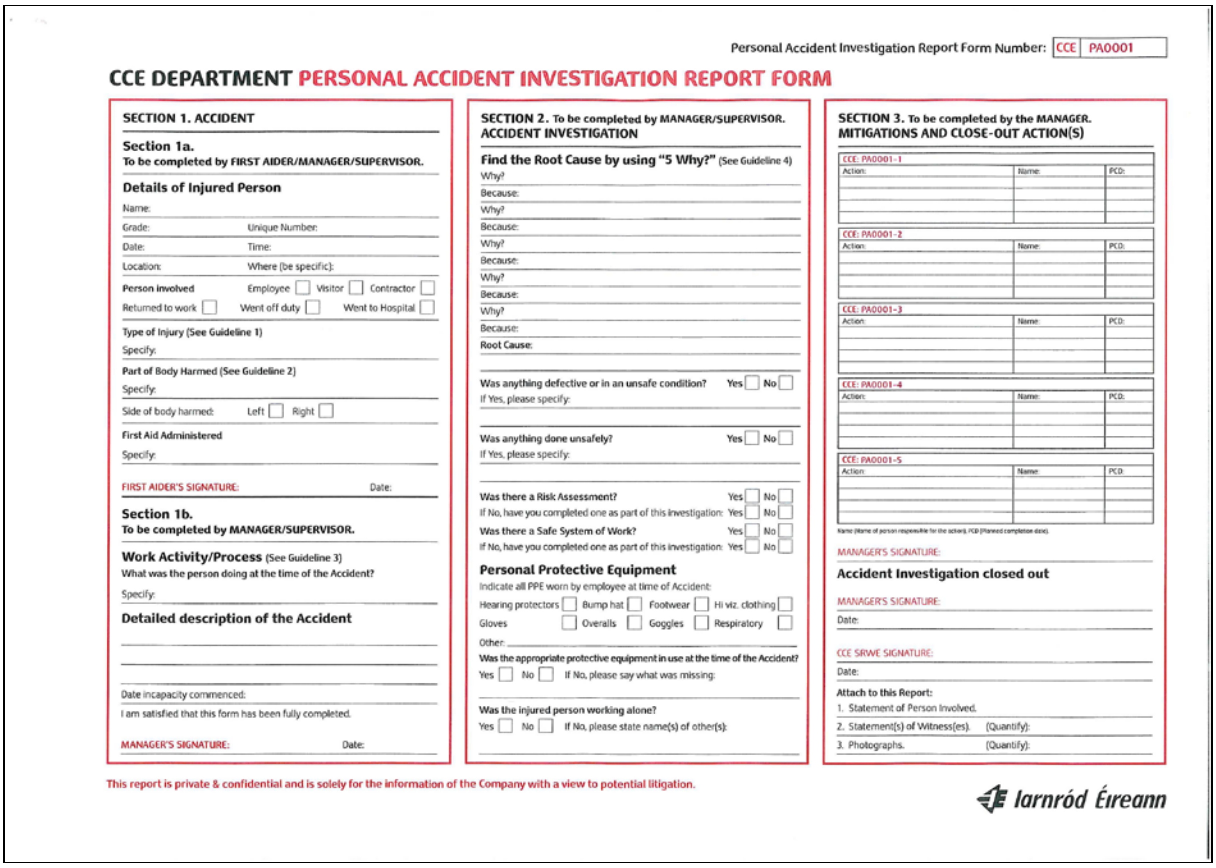
Figure 1: Mechanical Engineering Hazard Report Form

4.5 Introduction of Compliance Verification

The separation between production and technical teams enables the implementation of a continuous, natural internal auditing mechanism. For example, the Technical Manager Civil Engineering specifies the standard for bridge maintenance works, his engineers do the bridge inspections and issue the works orders to meet that bridge maintenance standard, and the production teams plan, schedule and execute the works orders to specification/standard. The Technical Manager, as the asset owner, then initiates sampled checks of the completed works through an internal auditing technique termed "compliance verification". While auditing is not a directly value-adding activity (in terms of Lean principles), the value of this mechanism is significant – engineering teams that are now operating at 97% compliance were as low as 35% compliant two years ago (e.g. records incorrect, tasks partially done, some tasks not done, etc).

4.6 Standardised across processes and departments

The new engineering SMS's are underpinned by standardisation at three different levels, namely standardisation of the SMS processes across the engineering disciplines, standardisation of techniques (e.g. root cause analysis) and standardisation in "look-and-feel" format. For example, the format and investigation process as in the Personal Accident Investigation Report Form in the Civil Engineering discipline (in Figure 2) is the same as for the other two engineering disciplines and also adopts the Lean "5 Why" technique (centre part of form in Figure 2) to re-enforce the use of root cause analysis and to improve decision making – the same technique is also used in root cause analysis in the production and support teams. The standardisation of the management action record (right hand part of form in Figure 2) similar to the Hazard Report Form in Figure 1 is also evident.



Personal Accident Investigation Report Form Number: CCE PA0001

CCE DEPARTMENT PERSONAL ACCIDENT INVESTIGATION REPORT FORM

SECTION 1. ACCIDENT

Section 1a.
To be completed by FIRST AIDER/MANAGER/SUPERVISOR.

Details of Injured Person
Name:
Grade: Unique Number:
Date: Time:
Location: Where (be specific):
Person involved: Employee ☐ Visitor ☐ Contractor ☐
Returned to work ☐ Went off duty ☐ Went to Hospital ☐
Type of Injury (See Guideline 1)
Specify:
Part of Body Harmed (See Guideline 2)
Specify:
Side of body harmed: Left ☐ Right ☐
First Aid Administered
Specify:
FIRST AIDER'S SIGNATURE: Date:

Section 1b.
To be completed by MANAGER/SUPERVISOR.

Work Activity/Process (See Guideline 3)
What was the person doing at the time of the Accident?
Specify:
Detailed description of the Accident
Date incapacity commenced:
I am satisfied that this form has been fully completed.
MANAGER'S SIGNATURE: Date:

SECTION 2. To be completed by MANAGER/SUPERVISOR.
ACCIDENT INVESTIGATION

Find the Root Cause by using "5 Why?" (See Guideline 4)
Why?
Because:
Why?
Because:
Why?
Because:
Why?
Because:
Why?
Because:
Root Cause:
Was anything defective or in an unsafe condition? Yes ☐ No ☐
If Yes, please specify:
Was anything done unsafely? Yes ☐ No ☐
If Yes, please specify:
Was there a Risk Assessment? Yes ☐ No ☐
If No, have you completed one as part of this investigation: Yes ☐ No ☐
Was there a Safe System of Work? Yes ☐ No ☐
If No, have you completed one as part of this investigation: Yes ☐ No ☐
Personal Protective Equipment
Indicate all PPE worn by employee at time of Accident:
Hearing protectors ☐ Bump hat ☐ Footwear ☐ Hi viz. clothing ☐
Gloves ☐ Overalls ☐ Goggles ☐ Respiratory ☐
Other:
Was the appropriate protective equipment in use at the time of the Accident?
Yes ☐ No ☐ If No, please say what was missing:
Was the injured person working alone?
Yes ☐ No ☐ If No, please state name(s) of other(s):

SECTION 3. To be completed by the MANAGER.
MITIGATIONS AND CLOSE-OUT ACTION(S)

CCE: PA0001-1		
Action:	Name:	PCD:

CCE: PA0001-2		
Action:	Name:	PCD:

CCE: PA0001-3		
Action:	Name:	PCD:

CCE: PA0001-4		
Action:	Name:	PCD:

CCE: PA0001-5		
Action:	Name:	PCD:

MANAGER'S SIGNATURE:
Accident Investigation closed out
MANAGER'S SIGNATURE:
Date:
CCE SRWE SIGNATURE:
Date:
Attach to this Report:
1. Statement of Person Involved.
2. Statement(s) of Witness(es). (Quantify):
3. Photographs. (Quantify):

This report is private & confidential and is solely for the information of the Company with a view to potential litigation.

Iarnród Éireann

Figure 2: Civil Engineering Personal Accident Investigation Report Form

4.7 Introduction of systematic Risk Management and Asset Plans

The new engineering SMS's implement structured and formalised risk management for both Occupational Safety and Asset Safety. With regard to Occupational Safety, local task-based Risk Assessments have been standardised and unwieldy, task-based safety monitoring checklists have been replaced with risk-based Safety Tours. The new risk-based approach focuses on the overall risk profile of a working site or a location provides better risk management than just tick-boxing a task-based monitoring sheet. According to the same mechanism as in the other Safety processes, the standardised Safety Tour forms are tracked and management actions are recorded and reviewed at monthly Safety Review Workshops.

In terms of Asset safety, a system of Risk Registers per asset type has been implemented. The technical teams for each engineering discipline have devolved Asset Safety accountabilities. Any Asset risk that manifests itself is recorded on the Risk Register and is contained and mitigated. The Risk Register tracks the close-out of these risk management actions and, where investigations of a risk identifies an unacceptable Asset Risk profile, changes to the asset to mitigate that risk profile is implemented through longer term Asset Plan actions. This technique enhances the visibility of the progress with mitigation actions that are often complicated due to material supply, supplier warranty, logistics or technical considerations.

4.8 Focus on accessibility to employees

We adopted an approach whereby the accessibility of the new SMS to the employees was maximised through Safety Stations. Safety Stations have been implemented at 85 locations throughout the country and are placed in very central positions in mess rooms, in supervisor Control Rooms (Figure 3) and in workshops (Figure 4) in order to maximise visibility and access.

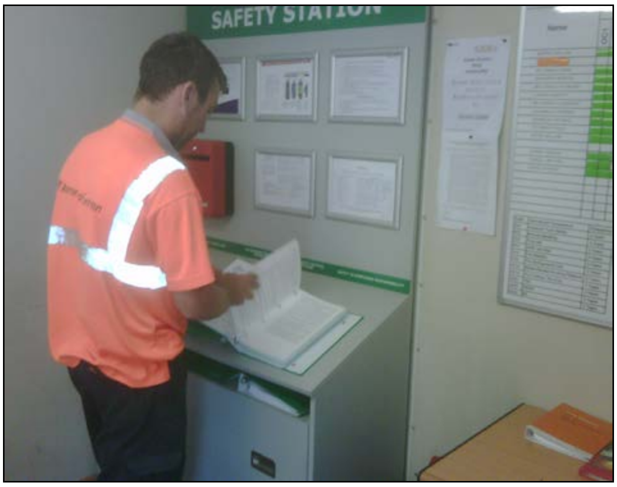


Figure 3: P-Way Inspector Safety Station

Figure 4: Workshop Safety Station

The Safety Station provides access to all the local Risk Assessments, Safe Systems of Work and SMS standards for that location, as well as other useful Safety information such as a location map showing fire exits, extinguishers and gathering points, First Aid Stations, certified First Aiders, Safety representatives, a record of recent briefings, a description of general Safety duties and a Hazard report book and box. The documentation on the Safety Station is printed on industrial paper that is resistant to tearing and robust for use in this type of rough and challenging environment. This Lean visual management technique contributed significantly to the adoption of the new SMS processes by our employees.

5 BROADER CHANGES ESSENTIAL TO IMPROVED SAFETY PERFORMANCE

The changes to the engineering Safety Management Systems as described in the previous paragraphs, though significant and positive, did not address all the organisational aspects required to actually improve Safety performance. Broader changes had to be implemented to ensure that the engineering organisation works and operates in a manner that is conducive to and capable of delivering the new Safety Management Systems and several other performance outputs as well.

Changes to engineering processes included establishing new operational control methods, the wide implementation of standardisation, the cultivation of new behaviours and the drive to reduce process wastes. All of these changes resonate with Lean Manufacturing principles and Lean thinking. These changes were not implemented in a "big bang" manner, but individual changes were systematically implemented in accordance with the objectives and time requirements of each engineering discipline and that discipline's 5-year strategic plan. Without big announcements and without fanfare, the change programme focused on getting employees to understand the reasons and benefits of each incremental improvement.

5.1 New operational control methods

Of the several improvements made to operational controls, the implementation of Control Rooms has been the single most influential change. A Control Room (also termed visualisation centres, communication rooms, war rooms, etc. in Lean Manufacturing) is a tactical control centre from which a line manager controls his teams. Live operational data that reflects the current reality is displayed and daily tactical decisions are driven by this data. Control Room meetings are short (40 minutes), control and action oriented, and typically happens daily with 8 to 12 managers, supervisors or employees in attendance. No chairs are provided, a strict agenda is followed, every attendee participates and leads the feedback on their area of responsibility and attendees take and deliver actions. As a virtual representation of the state of that line manager's operations, a cursory evaluation of the Control Room boards allows the informed visitor to understand the operation and its problems within a few minutes. More than that, the data-centric nature of the Control Room supports data driven decisions and aligns the actions and decisions of the attendees. Once Control Rooms were implemented, long standing or hidden production problems became very evident and were addressed. The behaviours of key individuals start to change as attendees now have a 1-day action time horizon (i.e. till the next Control Room meeting) instead of several days or even weeks before a problem is noticed and raised. This increased focus on tactical operational control have contributed significantly to productivity and cost improvements, including the reduction of bogie overhaul cycles from 4 weeks to 5 days and a 55% improvement of infrastructure touch-time on the electrified network.

Fifty seven (57) Control Rooms are constantly active at all the levels of the engineering organisation, from the Chief Engineer & Deputy CEO's Control Room (Figure 5), regional multi-discipline Control Rooms (Figure 6) down to Supervisor's Control Rooms such as for Permanent Way Inspectors (Figure 7) and for Telecommunications Supervisors (Figure 8). The data at the different levels of Control Rooms vary to suit the type of decisions taken at each Control Room and covers key performance indicators for production output, production programmes, procurement, cost, Occupational Safety and Asset Safety risk management.

Figure 5: Deputy CEO Control Room

Figure 6: Multi-discipline Control Room

Figure 7: P-Way Inspector Control Room

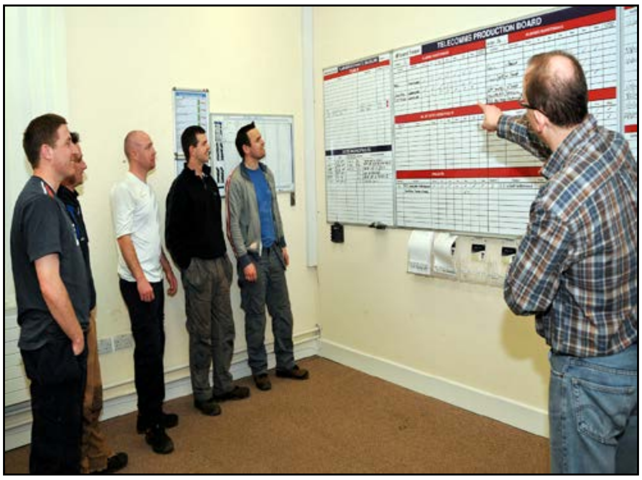


Figure 8: Telecoms Supervisor Control Room

In the absence of a significant behavioural shift by managers and supervisors towards "high operational control", improving the Safety performance in the engineering disciplines was not achievable. Where the implementation of a new Safety Management System (SMS) clarified the accountabilities for Safety, the implementation of Control Rooms and improved performance management gave the line managers the basic mechanisms to control their operations and to achieve those Safety accountabilities. More importantly, the impact Control Rooms has had on behaviours has been significant – and changes in behaviours are the foundation for changes in organisational culture.

5.2 Wide implementation of Standardisation

Adopting the philosophy that continuous improvement is not possible without standardisation, a range of standardisation programmes has been and is being implemented. The most extensive programme is the implementation of a standardised approach to workplaces and workplace organisation based on the Lean manufacturing technique of 5S (Sort, Set, Shine, Standardise and Sustain). The 5S technique consists of sequential phases of programmed activity whereby workplaces are sorted, set up, cleaned and sustained in a standardised format such that the production requirements are optimally met. The outcome is a workplace where wasteful activities are reduced and where non-conformances are alerted to employees by automatic and obvious mechanisms. A key success factor to a 5S programme is the involvement of employees at the coal face, as the new workplace processes that result from the 5S programme will affect the daily activities of those employees. As a 5S programme draws on several other Lean Manufacturing tools and techniques such as visual management, waste reduction, process mapping and team engagement, coaches were immersed into the teams to support with training and planning.

The 5S workplace organisation programme enabled employees to directly participate in resolving local Occupational Safety issues. The impact of the 5S workplace organisation programme was significant and extensive, as is evident from the photographs below. In the Mechanical Engineering & Fleets team the workshops were comprehensively re-organised (Figures 9 to 12), achieving a 28% increase in production capacity, reductions of around 20% in energy usage and improvements in morale and workplace Safety.

Figure 9: Bogie Workshop "Before"

Figure 10: Bogie Workshop "After"

Figure 11: Wheelset Workshop "Before"

Figure 12: Wheelset Workshop "After"

Visual management techniques were widely deployed (Figure 13), including waste management colour coding, marked equipment positions, floor colour coding, "storekeeper in stores" indicator, extensive tool shadow boards and Kanban systems (Figure 14).

Figure 13: Visual control and visual management

Figure 14: Wheelset Kanban

In the Civil Engineering & Permanent Way and Signalling Electrification & Telecommunications teams the 5S workplace organisation programmes delivered significant Safety and workplace improvements in Permanent Way depots (Figures 15 and 16), the equipment layout of road vehicles (Figure 17) and the workplace organisation of Telecommunications workshops (Figure 18).

Figure 15: P-Way Depot "Before"

Figure 16: P-Way Depot "After"

Figure 17: Road vehicle layout "Before" and "After"

Figure 18: Telecoms Workshop "After"

Further standardisation initiatives includes the standardisation of all the engineering business processes in an ISO9001 Quality Management System, the implementation of standardised Maintenance Instructions to support Asset Safety and the standardisation of the Safety management processes, forms and structures across the engineering disciplines.

5.3 Cultivating new behaviours

Changing an organisation's culture starts with establishing those behaviours that you want to see in a new culture. For example, compliance to Safety and technical standards was improved through the implementation of compliance verification as discussed in the previous paragraph. Two further significant changes that cultivated new behaviours were changes in the performance management approach and the communications philosophy.

Performance management in the engineering disciplines were changed through the implementation of standardised "A3 reporting" and the strict formalisation of performance reviews in "Review Week". Instead of managers and supervisors sitting down at the end of every 4-week period to write a backwards-looking report on their team's performance, A3-format reports that mirror the Control Room performance indicators were implemented. Actions per performance indicator are reflected on each A3 sheet (one per manager/supervisor and 6 per engineering discipline or supporting function) and the A3 sheet itself is the only monthly performance report. Time consumed in retrospective report writing was eliminated at every level of the engineering organisation and, instead, everyone is focussed on real-time, forward-looking performance planning. In addition, to counteract the tendency of teams to maximise their efforts in "doing" things while taking "checking" for granted (in their Plan-Do-Check-Act method), the third week of every 4-week period is now formalised as a Review Week. This arrangement is firm to the extent that the exact review meetings per day during Review Week is pre-specified 12 months in advance, confirming to all the importance of control and review.

The approach to communications with employees was changed in different ways at the different levels of the engineering teams. The objectives included to better engage the leadership of the teams, to improve the visibility of the leadership to the front-line employees and to improve the management of industrial relations. The introduction of six-monthly "Strategy Days" with managers and supervisors per engineering discipline created a forum to agree and communicate the 5-Year plans and for managers to network and present their progress on key initiatives with their peers. In addition, we introduced a range of annual "Meet the manager" visits by the senior engineering leadership to all the employees in all three the engineering disciplines. This willingness to meet the front line employees and take/respond to questions contributed positively to the understanding of the changes being implemented and the credibility of the changes. Lastly, the introduction of monthly regional industrial relations meetings (rather than ad-hoc national meetings) expedited the resolution of outstanding local issues and improved relations between unions and local managers, again establishing a behaviour that will improve trust and co-operation in future years. At all of these communications opportunities the importance of Safety, the changes in the management of Safety and the implementation of the new Safety Management System was discussed and promoted.

The challenge in most organisations is to improve the quality of management decisions. In the opinion of the writers of this paper, management decisions improve the closer those managers are to the coal face – a worm's eye view rather than a bird's eye view! The longer term objective is to stimulate "hands-on" management behaviours and to encourage managers to revert to direct observation of the coal-face processes and to make informed decisions on the improvements required.

5.4 Reducing process wastes

The reduction of process wastes has been an ongoing feature of the overall change programme and the examples are numerous. From simplifying production cells in workshops (e.g. all bogie production was centralised and "walking" waste reduced by 45%), reducing inventory holdings (e.g. by 21% in Mechanical Engineering and 17% in Civil Engineering), reducing motion wastes in workshops and vehicles (e.g. implementing rack-based line-side material supply and specialised road vehicle layouts to reduce manual handling), reducing over-processing (e.g. 34% reduction in discretionary spend costs across all engineering disciplines by replacing depot orders with requisitioned procurement), reducing waiting time (e.g. by outsourcing component overhauls and focussing workshops on high value-adding core activities) and reducing defective work (e.g. implementing quality performance indicators, root cause analysis and reducing defective work).

6 IMPROVEMENTS IN SAFETY PERFORMANCE – AND PERFORMANCE IN GENERAL

The new SMS was implemented in Mechanical Engineering & Fleets in June 2008. In terms of Occupational Safety performance, the level of Lost Time Accidents (LTA's) in this engineering discipline was reduced by 69% since the end 2007 up to 2010 (Figure 19). The trend in 2011 is an increase in LTA's from the 2010 total, but not significantly different. In terms of Asset Safety performance, the risk management process in the new SMS awards a qualitative risk value to each Asset Risk (based on a simple "5 by 5" risk matrix of severity vs. probability). The total sum of these Asset Risk values for each asset grouping per period are added together to give an overall total Asset Risk profile and the technical teams in that engineering discipline continuously work at lowering this overall risk. Since the introduction of the new SMS in Mechanical Engineering the Asset Risk profile for rolling stock has been reduced by approximately 60% over 3 years (Figure 20). Clearly these risk values do not relate to specific indicators such as equivalent fatalities nor can risk totals be amalgamated across engineering disciplines – the measure is qualitative and directed and focussing operational behaviours on risk priorities at the frontline.

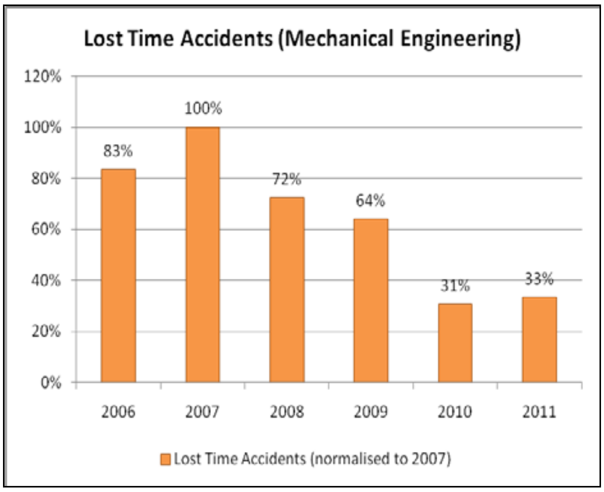


Figure 19: Accidents in Mechanical Engineering

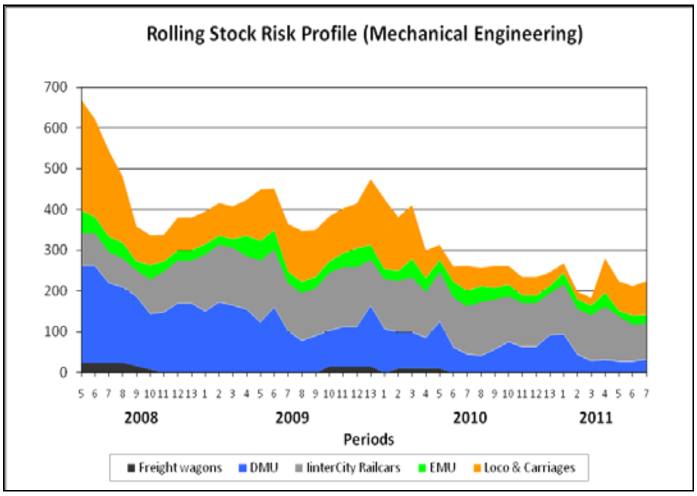


Figure 20: Asset Risk profile in Mechanical Engineering

Over the same period from 2007 to 2010, the total operational cost base of the Mechanical Engineering & Fleets discipline has been improved by 16% (Figure 21). Some operational cost savings manifest only in later years or result from the cumulative effect of incremental improvements from earlier years, thus the relatively slow cost improvement trend in 2008 and 2009. However, the Budget 2011 target of a further 10% saving on the Actual 2010 outturn is on track to be achieved.

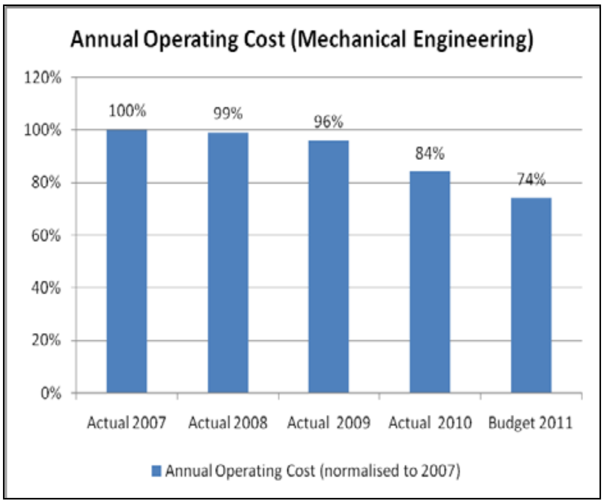


Figure 21: Costs in Mechanical Engineering

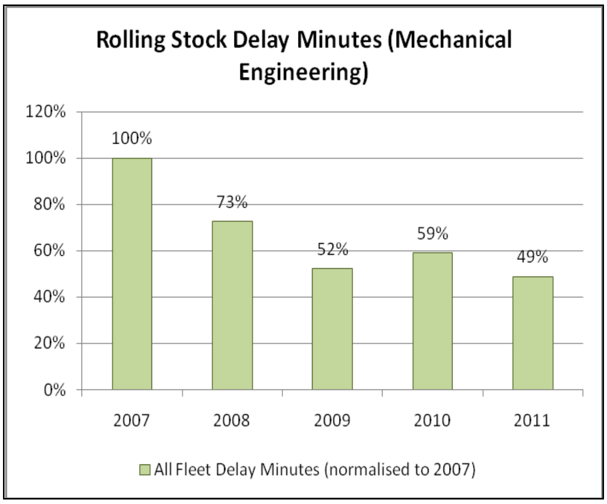


Figure 22: Performance in Mechanical Engineering

However, systematic improvements in both cost and Safety, while great, is of little benefit without quality or customer satisfaction? The most significant rolling stock impact on customer satisfaction and an indirect measure of quality is the measurement of rolling stock delay minutes due to rolling stock defects. Lowering the delay minute total per year reflects reduced train failures, reduced train delays, improved quality and increased customer satisfaction. Over the same period from 2007 to 2010, delay minutes attributable to rolling stock defects were halved through several Lean initiatives, standardisation and changes as discussed in this paper.

The important principle here is that while good Safety management is not "free", it is not a significant cost either. On the contrary, it is Irish Rail experience that the implementation of the principles of Lean in the workplace has reduced costs while also simultaneously improving Safety, improving morale, improving quality, reducing inventory levels and improving industrial relations. It is a way of thinking, not an initiative.

The new SMS was introduced in July 2010 in the other two engineering disciplines and no statistically significant conclusion can be derived from the current Safety Performance results in those two disciplines – the trend in LTA's in 2011 is the same as for earlier years (Figure 23 with 2011 LTA measured in June 2011) and the Asset Risk Profiles are only now being established (Figure 24). This "settling down" period after significant change is typical and to be expected.

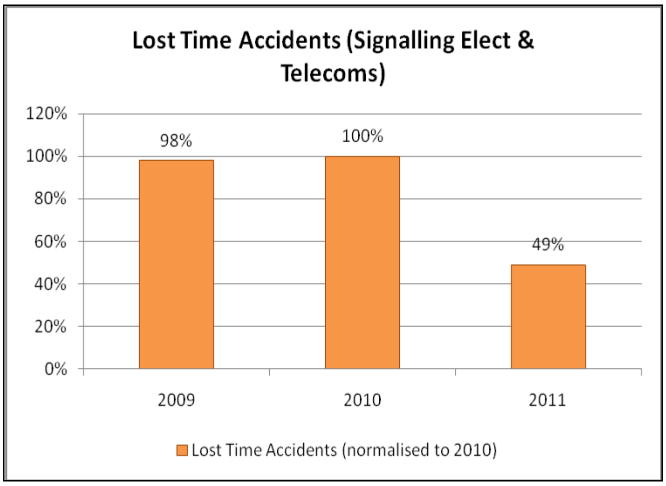


Figure 23: Accidents in Signalling Elect & Telecoms

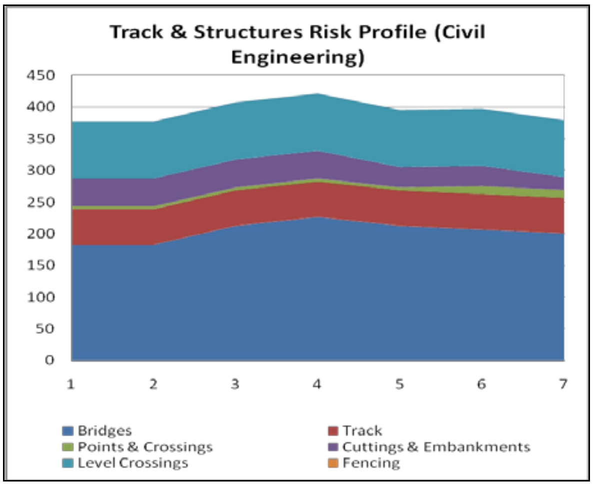


Figure 24: Asset Risk profile in Civil Engineering

However, the initial signs in Civil Engineering & Permanent Way and Signalling Electrification & Telecommunications are very encouraging – the introduction of risk management has been thoroughly and actively embraced, Lean-type mechanisms such as 5S, Control Rooms and practical problem solving have been adopted widely, internal compliance verification and audits are pro-active and driving further improvements, briefings and site safety briefings are actively used, and, most importantly, employees and managers are adapting their behaviours and are talking about, relating to and actively implementing the Safety Management System.

7 CONCLUSION

The new engineering SMS's could not (in itself) improve Irish Rail's Safety performance without the broader change programme to introduce new operational control methods and Control Rooms, standardisation and new behaviours. A Safety Management System does not affect behaviours in isolation of the prevailing organisational culture. Understanding that significant change is required and preparing for it is often the most important step to improving Safety in a railway - as it avoids a failed implementation and the associated increased system risk and a loss of management credibility resulting from a failed initiative.

In Irish Rail's experience, a simple and robust SMS implements relatively quickly and relatively easily, despite the volatile nature of industrial relations in the typical railway engineering environment. The use of Lean Manufacturing principles and Lean Thinking such as Control Rooms, visual controls, control point standardisation, root cause analysis, practical problem solving and closed-loop processes can contribute significantly to the robustness, simplicity and effectiveness of that SMS. Lastly, and perhaps the most important observation, the implementation of any change (such as a new SMS) is best achieved if actively led by the leadership of the team, in the trenches, with clear vision and in a hands-on manner.