Competency Management Systems to Support Accident and Incident Investigators

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Abstract

Accident and incident investigators play a central role within safety management systems. Their recommendations help to ensure that hazards do not recur. Their reports describe previous hazards that help to inform subsequent risk assessments. Their findings can act as a catalyst for change not only within individual organisations but across entire industries. There is little agreement about the skills and expertise necessary to meet these requirements. The following paper, therefore, identifies generic competency requirements for accident investigators. We recognise that there will be considerable disagreement over relevant expertise in particular countries and for particular industries. However, we must start a debate in this area if we are to encourage leading practice in the exchange of safety lessons around the globe.

Introduction

Incident and accident investigation plays a critical role within the safety management processes that protect many safety-related systems. The recommendations from these investigations help to ensure that past mishaps do not recur. They also guide the subsequent allocation of finite development and maintenance resources, for example, by helping to provide evidence about the frequency and consequence of particular hazards.

Given the importance of mishap investigations for systems safety, a number of international bodies have begun to consider the competencies and skills required by accident investigators (ICAO, 2003, ERA, 2010). These organisations have recognised that additional training is required to support a range of objectives for mishap investigation:

1. *Consistency.* Similar incidents should lead to a similar set of recommendations irrespective of the individual in charge of the investigation process. Unless consistency can be encouraged then there is a danger that we will suffer piecemeal approaches to adverse events. Different improvements will be recommended by different investigators over time. In contrast, training can be used to encourage similar approaches to similar incidents using recognised tools and techniques;

2. *Open Mindedness.* Investigators should consider a broad set of causal and contributory factors without being unnecessarily biased towards particular findings. An individual's background and experience can influence their findings (Lekburg, 1997). Training can help investigators to explore wider perspectives on the course of an adverse event. Training can also encourage them to seek additional input from colleagues and appropriate experts where mishaps stem from factors that lie outside their technical competency;

3. *Technical Competency.* Individuals should have a range of core technical competencies that enable them to coordinate an investigation. This can include knowledge of the key processes and systems that support everyday operations. They must also be aware of previous incidents that have affected an industry. Without this basic level of technical competence, it is hard for investigators to identify appropriate external support when it is required. Paradoxically, they must know enough to recognise the limits of their own competency;

4. *Organisational, Legal and Regulatory Insight.* Investigators should be sensitive to the relationships that characterise interactions between key stakeholders. It is also important that investigators understand the legal and regulatory context of any mishap. These insights are critical if they are to direct recommendations towards those parties that are best equipped to ensure their implementation. However, it is also important that the members of an investigation team retain a degree of independence from the various stakeholders;

5. *Human Factors Competence.* Accident investigators should be trained in the fundamentals of human factors engineering. It is important that we go beyond any immediate errors to consider those factors

that make individuals and teams more likely to suffer from slips, lapses and mistakes. Investigators must identify the underlying causes of human error rather than focussing on particular unsafe acts or omissions. Training is required to ensure that this analysis is based on an understanding of the interactions between cognition, perception and physiology.

6. *Software Competence.* Computational systems create a host of new challenges for incident investigation. Logical errors do not yield the same physical evidence as other forms of failure. The increasing integration of software systems and their inherent complexity places growing strains on many investigatory agencies. In most cases, external experts supplement full-time investigatory staff in this area. Digital forensics experts are in short supply.

7. *Expert Coordination***.** Investigators should be trained to assess the findings from external experts and integrate them into a final report. This is non-trivial given that the lack of consensus in many technical areas of systems engineering. Investigators must, therefore, be prepared to seek second opinions when they lack sufficient confidence in expert advice.

8. *Timeliness.* Accident investigators must identify appropriate recommendations as soon as possible to reduce the likelihood of any recurrence. This is non-trivial given the multi-party nature of many investigations. Some investigatory agencies have placed limits on the time between an adverse event and the publication of interim recommendations. Training can provide project management skills without encouraging undue haste that leads to erroneous or misguided conclusions.

9. *Cost effectiveness.* Investigators must optimise the finite resources that are available to their teams. It is impossible to pay for every test that is proposed in the aftermath of an adverse event. There are also limits on the external input that can be financed. Investigators must, therefore, be trained to optimise their use of available financial resources while at the same time ensuring the timeliness and completeness of their analysis.

10. *Professionalism.* Investigators have to secure evidence and elicit the support of many different stakeholders. They must work with individuals and groups who are under extreme stress. This is made all the more difficult when investigators have to work at extremely short notice under a range of climatic conditions at sites that can be hazardous without sufficient precaution.

11. *Sensitivity.* In addition to technical competency, investigators must also be sensitive to the impact of their work upon survivors, including individuals involved in the causes of a mishap, to the bereaved, to the media and to external agencies involved in an investigation. These core competencies are just as significant as the technical and organisational skills listed above. They often require a combination of selection procedures and training.

This is a partial list. For example, some investigatory agencies train investigators in a range of Team Resource Management skills (Johnson, 2003). However, it should be apparent from this initial summary that accident investigation requires a host of technical and non-technical competencies. It should also be apparent that prior career development and candidate selection are unlikely to guarantee every new investigator will possess all of these attributes.

Existing Training for Mishap Investigation

This section summarises national and international guidance for training incident investigators. Subsequent sections argue that training provision is often fragmentary and poorly tailored to the demands of many investigations.

Aviation: The International Civil Aviation Organisation's (ICAO) Annex 13 on Aircraft Accident and Incident Investigation identifies the role of the investigator-in-charge as: "A person charged, on the basis of his or her qualifications, with the responsibility for the organization, conduct and control of an investigation". Supplementary guidance specifies the qualities that characterise an investigation. Part I of the ICAO Manual of Aircraft Accident and Incident Investigation (Doc 9756) contains a section on the attributes that should be shown by the individuals in these investigation teams. They must possess "an inquisitive nature, dedication to this kind of work, diligence and patience". The ICAO makes it clear that it is not acceptable for someone with a general technical knowledge of aviation to be nominated as an investigator. This is seen to be a skilled and specialist

role. In addition to the obvious technical skills they must also show a respect for human dignity. The ICAO guidance also stresses that investigators must know about their legal obligations and responsibilities. This is important when they have to gather evidence or encourage cooperation from individuals and groups who may not immediately be motivated to assist an investigation. In such situations, they will have to use significant inter-personal skills; summarising the importance of their role for future safety in order to encourage participation in an investigation. Every investigation should be supported by at least one experienced investigator with significant practical expertise of previous investigations. However, the range of technical expertise identified for aviation investigations quickly makes it apparent that a multi-party approach is required. Few individuals will have sufficient insight to be competent across incidents that involve aeronautical engineering, aviation and aerodrome operations, air traffic management, meteorology, aerodynamics, software systems, human factors, design, etc.

ICAO Circular 298 presents Training Guidelines for Aircraft Accident Investigators that extend the attributes described in ICAO document 9756. These guidelines make it clear that a career structure should be established for training investigators as they progress from junior team members to investigators-in-charge of large aircraft incidents. One aspect of this development process is the need for investigators to understand detailed evidence in 'specialised areas' listed in the previous paragraph. Circular 298 reiterates the requirement in 9756 that investigators must have an in-depth understanding of State regulations and legislation. The guidance also stresses that investigators must have a broad training to cover the diverse factors that must be considered in many investigations. These include but are not limited to:

- a knowledge of aircraft accident investigation tools and techniques;
- an understanding of aircraft operations;
- an understanding of technical aspects of aviation and avionics;
- the ability to procure external technical assistance;
- the ability to manage the resources required to support multi-party investigations;
- the ability to maintain 'chains of evidence' in collection, documentation, preservation to presentation;
- the ability to identify and root causes and contributory factors from evidence;
- the ability to identify appropriate safety recommendations from root causes and contributory factors;
- the ability to write a final report that meets both State and regulatory requirements, following ICAO Annex 13.

The ICAO guidance has been interpreted by many states, including the US and the UK, to develop programmes that build on the investigators' previous knowledge and expertise. On-the-job training is supplemented by an initial 'orientation' programme focussing on the legal and regulatory context. Investigators should be prepared for their responsibilities when they first arrive at the scene of an accident. They must then be able to apply the procedures and principles that they have been taught so that they can follow the investigation from the collection of evidence at the site through to the analysis of factual and causal information through to the presentation of recommendations. Some investigatory boards also close the feedback loop by encouraging investigators to consider the extent to which industry and regulators implement necessary safety improvements. This initial training is supplemented by specialist courses. However, it is important to recognise that accident investigation is not well supported in terms of training provision by agencies outside the investigation bodies. The courses offered by Cranfield University in the UK and Embrey-Riddle University in the United States are notable exceptions.

The ICAO guidance makes it clear that there should be a sufficient interval between formal courses so that investigators have the opportunity to apply their training in their work. This supports the consolidation processes that guide subsequent learning. Otherwise, there is a danger that investigator will be overwhelmed by material that may not seem directly relevant to their everyday tasks. This is particularly important when courses are presented by technical experts who may not themselves by familiar with investigatory processes. For instance, it can be particularly difficult to apply many of the abstract human factors models in the aftermath of an adverse event when there may only be limited evidence of the perceptual and cognitive influences on a flight crew. In such circumstances, investigators may have to develop abbreviated models that are supported, where possible and appropriate, by insights from empirical studies in similar contexts.

Railways: The previous paragraphs have summarised a range of guidance provided for the training of accident investigators across the world's aviation industries. Such initiatives are important because they can increase confidence in the recommendations that are identified following mishaps that occur to similar systems in other States around the globe. Ensuring common training standards helps to encourage the exchange of safety information through the validation of the individuals responsible for identifying the lessons from previous

failures. Unfortunately, national investigatory bodies have shown considerable differences in their interpretation of these ICAO guidelines. Some states have established career development plans for investigators that help to ensure and maintain competency. Other nations recognise that they cannot afford to meet the costs associated with the range of expertise recommended for investigatory bodies and routinely call on assistance from bodies in other nations once a mishap occurs within their air space. A small but significant number of states lack coherent strategies for ensuring the skills and expertise of their investigators.

The situation in the aviation industry is not mirrored in railway accident investigations. Here there is a lack of international guidance on core requirements for investigators and investigatory bodies. Instead, there is a patch work of national initiatives where leading practice in one state is seldom mirrored in other national agencies. In many cases, the training of rail incident investigators has been shaped by experience gained in the aviation industry. This cross-fertilisation of core skills and competencies is arguably best-supported in States that have developed cross-modal investigation bodies. For instance, the US National Transportation Safety Board maintains a Training Center in Ashburn, Virginia. They provide a two day orientation programme that is designed for a range of different stakeholders, including professional investigators from the NTSB and other accident investigation authorities from around the globe. In addition, the course is tailored form the potential participants in an NTSB investigation under the multi-party approach described earlier. The training is also designed to support "investigative, safety and management personnel employed by railroads or equipment/component manufacturers; manufacturers of hazardous materials; civilian and military agencies; and related labor unions (as well as) members of the academic community attending for research purposes (on a space-available basis)". These comments are very important. This paper deliberately focuses on training and competency requirements for investigators employed by national bodies. However, many of the arguments also apply to the increasing number of mishap investigators who support safety management systems across a broad range of operational and infrastructure organisations.

The purpose of the NTSB rail investigation orientation course is to explain their investigatory process and to identify their expectations of the participants in an investigation. For example, one session deals with the authorities and limitations of the Board. Additional modules look at the 'go-team' concept which creates a core of investigators who deploy to the site of an accident as soon as it has been reported. The course looks at the NTSB approach to multi-party investigations and describes the analysis that must take place after the site of an accident has been secured and the evidence gathered. Further sections consider the support and information that can be provided to families of accident victims. The course concludes by explaining the techniques that are used to derive recommendations and then encourage their adoption. An important feature of the NTSB curriculum is that it identifies learning outcomes for each of the courses that it offers. By the end of the rail orientation programme, participant will be able to:

- "Discuss how the NTSB investigators work on-scene at an accident and the role of a "party" member
- Work in a close and coordinated manner with the NTSB investigators on-scene
- Describe the NTSB accident investigation from initial notification to final board meeting and recommendations
- Explain what types of services and support are available to family members of victims of railroad accidents
- Describe the role of the NTSB Office of Public Affairs in the release of relevant and appropriate information to the public." (NTSB, 2011).

This two-day investigation orientation course is the only training provided by the NTSB that is specifically tailored for the rail industry. However, the introductory content can be supplemented by more focussed material that is shared across industries. Recall that the NTSB is a multi-modal agency address accidents in the rail, highway, aviation, maritime and pipeline industries. For instance, the Training Centre also offers a 3-day course in 'Transportation Disaster Response'. This is intended for emergency responders, including investigatory agencies. This extends the audience identified for the rail orientation course to include local and federal emergency responders, such as planners and managers; "as well as members of organizations and agencies with accident response roles". A case study approach is adopted where participants can learn from investigators and police personnel who responded to a range of previous mishaps. The need to extend the audience for this course arguably illustrates a fundamental problem for all forms of investigation training. In most countries there are not enough investigators to justify the maintenance of a bespoke series of courses. This creates particular problems in Europe where there is a pressing need to exchange leading practices between member states at a time when most nations only have a handful of specialist investigators.

The European Railway Safety Directive 2004/49/EC creates a framework that is intended to ensure the safety of railway operations across member states. This framework includes an obligation for each nation to create a safety authority and an accident investigation body. The intention is that the investigation agency should identify appropriate recommendations from all serious accidents on the railway. The European Railway Agency (ERA) has supported the implementation of the Directive through the creation of working groups and plenary meetings involving the national investigatory bodies from a range of member states. These meetings occur several times each year and provide a forum for the exchange of leading practice. They also supplement that regional activities that take place when, for instance, the German-speaking or Nordic investigation agencies organise meetings of mutual interest.

The European Railway Agency's Safety Unit has led a range of studies into topics of mutual interest and importance across the individual member states. This has included a survey and analysis of the tools and techniques that might be used to support each stage of the investigatory progress from the notification of a railway mishap, through the collation of evidence and causal analysis to the publication of recommendations and implementation audits. More recently, ERA has created a working group to support the training of railway accident investigators. This initiative is intended to meet many of the objectives that were summarised on previous pages – including the consistency of similar investigations conducted in different member states. As part of this initiative, the Agency has for the first time begun to sketch a curriculum for railway accident investigators. As one might expect, many aspects of the proposed curriculum are similar to those promoted by ICAO and implemented by agencies including the NTSB. However, the scope and detail in the framework extend those cited in earlier documents. It is also anticipated that these will be extended over time in key areas that are significantly different between the rail and aviation industries, such as techniques for investigating the impact of manual workload on trackside workers.

The Impact of Training on Competency

These initiatives across the rail and aviation industries reflect a particular view of competency for accident investigators. The development of appropriate training helps to define a professional view of an occupation that has previously relied on technical competence and experience rather than formal qualifications or an explicit path for career development. This forms a strong contrast with other areas of both industries where there are clear notions of competency. For instance, the US Coast Guard (2005) has introduced a competency framework that is intended to maximise their human resources. They define competency to be "A collection of tasks with the associated skills, knowledge, abilities, and wherewithal (tools, methods, information, doctrine, procedures, materials, etc.) needed to perform the tasks to a predetermined, measurable, performance standard. The tasks are usually related as parts of a larger process in support of or contributing to the goals of the organization, unit, or work group." By taking a more structured approach to the definition and measurement of core competencies the Coast Guard aims to ensure the best fit between existing personnel and the changing demands that are being placed upon the organisation. The ability to plan for career development and progression is essential at a time when Federal budgets require many similar agencies, including National Investigatory Agencies, to do more with less.

The UK Office of the Rail Regulator (2007) has also recently published detailed guidance on training and assessment. This defines competence to mean "the ability to undertake responsibilities and to perform activities to a recognised standard on a regular basis". It is the product of theoretical knowledge and practical skills derived from experience. It also can include attitudinal markers such as a willingness to work to agreed standards, using approved tools and techniques. This forms a significant contrast with many investigatory agencies that have sustained a high degree of independence that often undermines objectives including open-mindedness and consistency, identified in the opening pages. The fact that many national bodies are only beginning to consider the use of common tools and techniques illustrates this caveat.

The railway competency guidelines also make it clear that the context or environment will have a profound impact upon an individual's ability to perform particular tasks. This is especially important when individuals are learning new skills or techniques. The ability to learn through mistakes or to benefit from firsthand experience help develop confidence and proficiency. A positive learning environment can also help investigators identify their weaknesses and address them without fear of reprisal. Such opportunities are difficult to ensure within many investigatory agencies that only have a small number of mishaps each year. This also makes it difficult for new investigators to pioneer new techniques as the nature of accidents change over time; for instance with the rapid introduction of software controls.

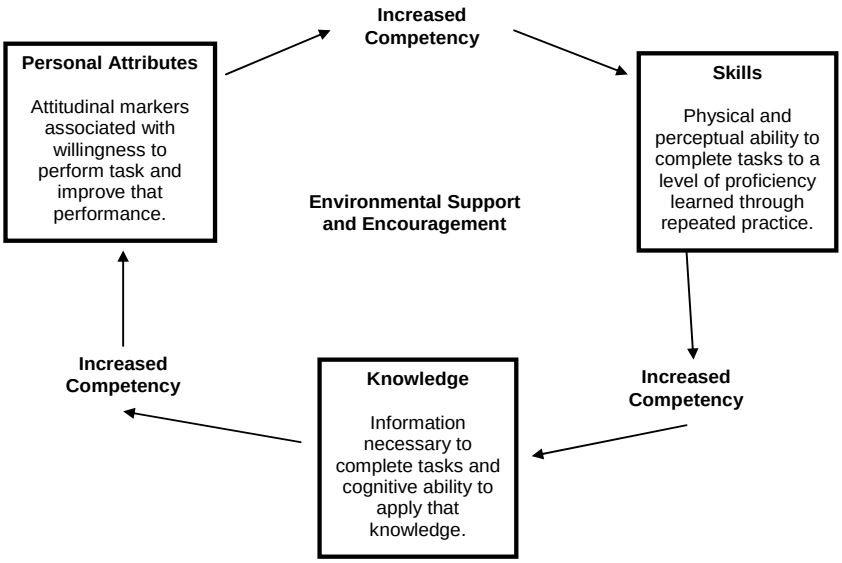

Figure 1: An Individual's Perspective on Competence

Figure 1 builds on concepts of competence. The focus here is on the development of an individual, including a member of a mishap investigation board. The intention is to encourage the personal attributes that motivate a member of staff to improve their performance of critical tasks through knowledge and skill development. This virtuous circle depends upon appropriate support from the working environment; in other words senior staff and colleagues must recognise the need for individual development in core competencies and must provide appropriate opportunities for personal development. It is also important to stress that competency assessment is conventionally used throughout a career. Once an investigator is considered to have reached an initial level of competency, further training can extend their technical skills and knowledge. It can also enhance leadership and management talents, including financial planning. A host of other skills are often necessary ranging from self-confidence through to personal fitness that are explicitly represented in the competency programmes of aviation and rail operations but are often only implicitly represented within the career development schemes that support accident investigators.

UK rail competency guidance, cited above, makes it clear that developing competence "will not in itself guarantee safety, but it will improve the predictability of good performance". Hence there is a strong connection between the objectives of this initiative and the aims of many national and international investigatory agencies seeking to promote common approaches to the analysis of similar problems. Unfortunately, this guidance has not previously been used to support the training of mishap investigators. This is regrettable because such initiatives provide useful frameworks that can be used to structure career development within the emerging profession of accident and incident analysis. For example, the Office of the Rail Regulator argues that the development of a competency management system should proceed by developing a list of tasks and responsibilities; going beyond the enumeration of attributed provided in the opening sections of this paper. This analysis can then be used to derive objective criteria for the knowledge, skills, experience and qualifications that are necessary to carry out the work. By analogy, it would be necessary to establish clear criteria for investigators' education, assessed in terms of relevant degrees or specific courses as well as more advanced training, their professional status, assessed in terms of recognition by a recognised body to Chartered Engineer level, and experience, assessed not simply in terms of the length of time in post but participation in major investigations. The guidance goes on to argued that "Many tasks require more skills and knowledge than any one person possesses. In that case they will have to be tackled by a team and you should specify the required collective competence of the team as a whole". These caveats seem particularly appropriate for the multi-party approach to investigation that supports many national agencies.

Existing guidance on competency management can also be used to guide the assessment of accident and incident investigators. This topic is arguably the most contentious area of this paper; given the relative lack of objective assessment in many agencies. However, the need for consistency both within and between national reporting systems together with the increasing complexity of many investigations reinforces the importance of a professional approach in this area. There is little point trying to identify competency criteria unless they can be

applied to identify those areas in which investigators might need additional support – for instance through additional training.

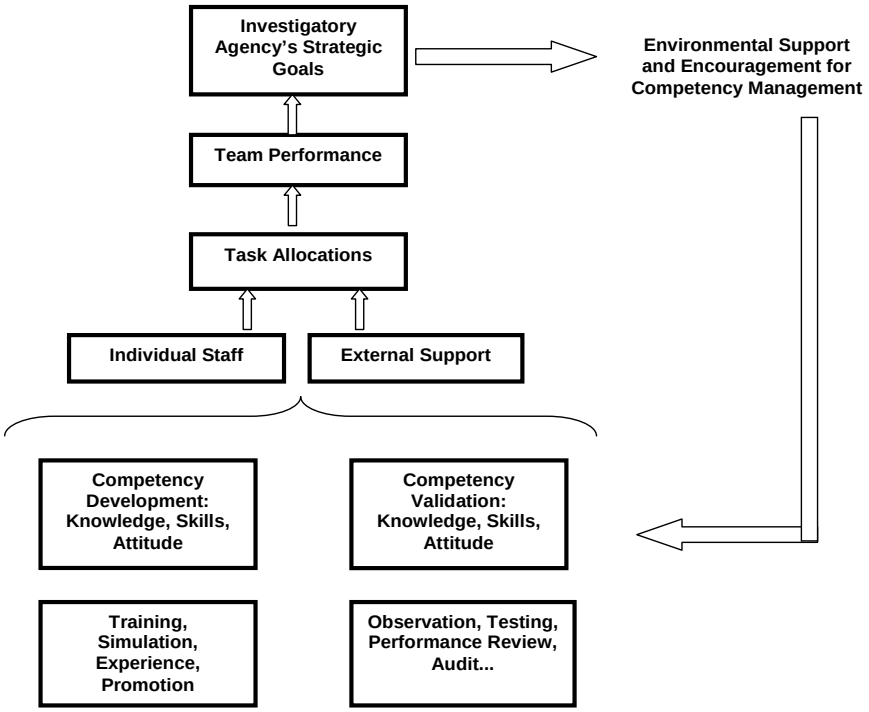

Figure 2: An Organisational Perspective on Competency Management

Figure 2 provides an organisational view of competency management. As can be seen, the performance of individual staff members and also of external experts depends upon both their level of competency, defined in terms of the knowledge, skills and attitudes from Figure 1. This can be developed through training, through the use of simulated drills and experience. Competency can also be extended through the promotion of indivisual staff members. However, the success of these initiatives also depends upon validation processes including observations of performance, testing following training, reviews and audits. These processes help to ensure that competency development activities have their intended benefits for an organisation. However, Figure 2 also shows that investments in human resources need not yield improvements unless suitable individuals are allocated to the teams that conduct most mishap investigations. Group-based performance ultimately determines whether or not an organisation can meet its key strategic goals. This leads to an iterative cycle in which the performance of individual team members is, in turn, determined by the learning environment created by the organisation that they work for.

It is ironic that competency management is an increasing focus of many accident investigations that focus on the interactions between safety culture, organisational issues and human error. At the same time, these frameworks are only just beginning to be applied within national investigation agencies. The main aim of a competence management system is to create a documented cycle of activities within an investigatory board that is intended to promote the learning outcomes enumerated in the opening sections of this paper. It also helps the board to identify areas for further development both within an individual's career trajectory but also across the agency as a whole. In particular, management systems enable senior staff to identify and respond to potential skills gaps across an organisation. These frameworks also support the assessment and reappraisal processes that help to ensure the validation of training programmes that include practical experience, theoretical tuition and simulated exercises. The aim of any evaluation is to ensure that individuals and teams can achieve their intended tasks. This is not a simple judgement; over time competence, proficiency and expertise should increase.

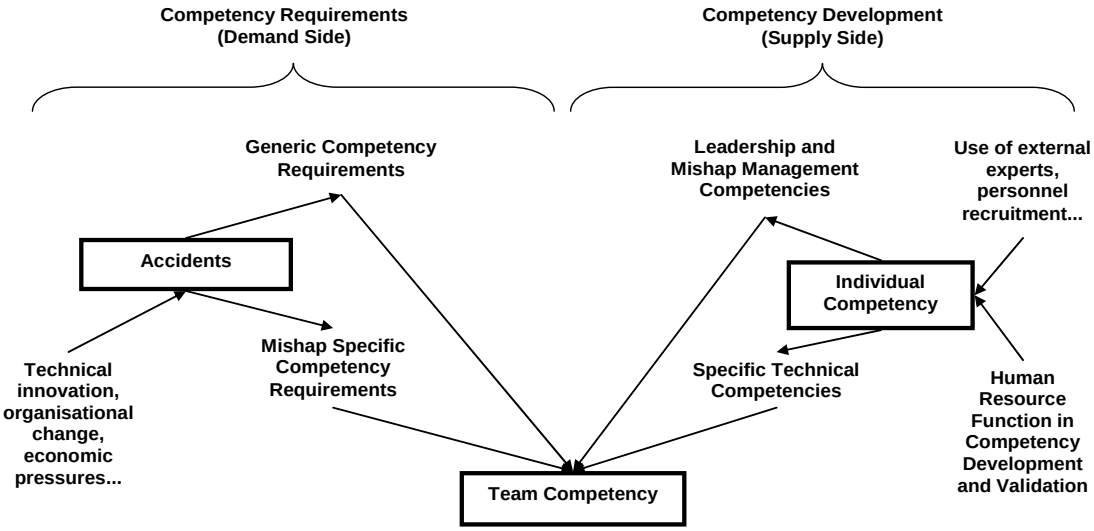

Figure 3: Outline of a Competency Management System

Figure 3 extends the previous analysis to illustrate the manner in which competency management systems attempt to balance supply and demand for staff resources. As can be seen a wide range of factors including technical innovation and economic pressures can create the preconditions in which accidents occur. These factors impose specific technical competency requirements on an investigatory team in addition to the core generic skills, such as the ability to draft recommendation or to distinguish between causal factors and contributory events. At the same time, supply-side influences help to determine an investigatory board's ability to meet the demands imposed by adverse events. Human resource departments play a key role in creating environments that nurture individual competency.

Constraints on Competency Management Systems

Competency management systems such as those encapsulated within Figures 2 and 3, offer few guarantees that investigators will exhibit all of the desired characteristics that were listed in the opening paragraphs of this paper. Competent people still make mistakes. However, recent initiatives by the NTSB Training Centre and by a host of international bodies including the ICAO and European Railway Agency illustrate the pressing need to support the training and validation of accident investigators. Considerable work remains to be done before we can adequately address a host of detailed concerns that complicate the application of competency management systems to mishap investigation boards. The closing paragraphs present a subset of these remaining issues.

- *Tensions between Consistency and Local Needs.* This paper has argued that competency management systems can improve the consistency of accident and incident investigations across national borders. However, there is a tension between the need to treat similar mishaps in a similar way and the requirement to explicitly support local and regional issues. We cannot assume that training techniques developed for one large national investigatory body might also be suitable for a neighbouring state with a small number of adverse events and correspondingly fewer resources to devote to any investigation. In the future it may be necessary to identify a common core curriculum across nations and at the same time allow the flexibility that is required to tailor more advanced investigatory training to local and regional requirements.

- *Tensions between Consistency and Industry Specific Requirements.* Previous sections have described how many states have support the professional development of investigators through multi-modal bodies. The small number of individuals needed to respond to relatively few incidents in many industries means that there are insufficient resources to offer bespoke training programmes devoted to railway investigations or maritime enquiries. However, the creation of a professional investigatory body that extends across several domains can create a national pool of investigators of sufficient size to justify the development of a more elaborate curriculum. Holding an advanced human factors course is justified with 5 investigators but may not be cost effective if there is only one or two participants

within a particular industry. Unfortunately, multi-modal agencies create a host of additional concerns. In particular, we cannot expect that techniques developed for the aviation industry can be automatically transferred to support rail accident investigations. Industry structures including regulatory provision are very different, the role of technology can be poles apart, the influence of manual working or of sub-contracting all combine to create industry specific competency requirements.

- *Tensions in Assessing the Cost Effectiveness of Training.* One of the main motivations for writing this paper was the observation that many investigators are sent on courses provided by academic and commercial organisations that have little or no discernible impact on their subsequent investigations. Many of the offices of national investigatory bodies are stocked with wall charts and manuals for causal analysis techniques that are abandoned within weeks or months of a course. It is, therefore, important to derive metrics and methods for assessing the cost-effectiveness of the training that we provide. Figures 2 and 3 provide an overview of how this might be done. However, they lack detail and greater attention is required if we are to ensure that competency management systems equip staff members with the skills and expertise that they need to complete their everyday tasks. Too often we focus on competency in terms of an individual's ability to answer specific knowledge-based questions at the end of a short period of study. In the future, additional support is required to assess the longitudinal value added by competence management systems during the career of an investigator, as the nature of incidents and accidents changes over time.

- *Tensions in the Validation of Competency.* Ultimately, the value of any incident or accident investigation depends upon the recommendations that help to avoid future recurrences of an adverse event. This is not simply determined by the competence of the investigator. It is also influenced by the regulatory regime and by a host of cultural influences that affect safety-critical industries. However, one aspect of the validation of competency has to be an assessment of the extent to which an individual contributes to the generation and acceptance of safety improvements through the publication of their recommendations. This is important because many investigatory agencies still claim to yield most influence through informal channels of cooperation that arguably undermines the independence and public accountability of a professional investigatory agency.

As mentioned, this list provides a partial summary of the concerns that remain to be addressed before we can develop a competency management system that is appropriate for future generation of accident and incident inspectors. The key point, however, is that unless we begin to consider these issues then there is a danger that safety management systems will be guided by ad hoc insights from previous mishaps that are influenced as much by the previous experiences of the investigator as they are by the characteristics of the adverse event.

Conclusions and the Problems of Validation

Accident and incident investigators play a central role within safety management systems. Their recommendations help to ensure that hazards do not recur. They help to inform subsequent risk assessments. Their reports can act as a catalyst for change not only within individual organisations but across entire industries. There is a need, therefore, to carefully consider the skills and expertise that are relevant to accident investigation. There have been recent initiatives in both the United States and Europe to establish training courses in accident investigation. This paper has summarised these initiatives and identified a generic skill set that can guide curriculum development. We recognise that there is considerable scope for disagreement over the relevant expertise for particular countries and particular industries. However, we must start discussions in this area if we are to equip our investigators with the skills necessary to identify lessons learned from adverse events around the globe.

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Biography

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