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THE PARADOX OF RULES: PROCEDURAL DRIFT IN COMMERCIAL AVIATION

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This paper considers the inescapable tendency for procedures and remedial rule-based interventions in organisations to "drift" in a fashion that is often inconsistent with the intentions of those responsible for original system design. Taking Snook's (2000) notion of *Practical Drift* as a point of departure, the paper discusses a range of examples from commercial aviation, with a view to establishing the potential implications for safe and efficient socio-technical systems. The paper argues for a programme of research into the nature of such drift and its driving forces.

Background

The notion of "Practical Drift" (Snook, 2000) originates in the search to establish why formal safety procedures may not assure system safety. This paper takes as its point of departure Snook's book *Friendly Fire: The Accidental Shootdown of U.S. Black Hawks Over Northern Iraq*. Snook's idea of *Practical Drift* has been renamed *Procedural Drift* here as this term seems better suited to aviation. Maurino, Reason, Johnston & Lee (1995) document the potentially adverse impact of hidden latent organisational failures on aviation safety. Readers are invited to consider the role of *Procedural Drift* in the genesis of such latent failures within complex socio-technical systems. Moreover, the thrust of the argument below is supported by recent findings from Line Operations Safety Audits (LOSA). The objective here is to document examples and issues relating to aviation *Procedural Drift* preparatory to a programme of research into its origins, significance and impact.

Introduction

For the purposes of this paper, Snook's basic argument can be modified and recast as follows:

- Systems development, procedures for new aircraft, etc. are typically derived from a global or formal perspective. The consequent rules are abstract and normative, and generally pay minimal attention to applied realities or operational demands. This dominant analytic framework tends to be established at the system design phase. This sets the framework against which various types of "drift" subsequently occur.
- New management teams, if modifying a system, take for granted their assumptions and the outcome of management debate to be "obvious". They consequently tend to assume that their local, or particular, consensus has all the characteristics of a rational, universal or generic system response. This is all the more so where a management consensus has been hard fought for. By virtue of such putative "obviousness" management rarely explains or documents the rationale, objectives or assumptions underlying their new procedural interventions.
- The rationale, justification and history for the management consensus are often unclear to successors, who interpret - rather than learn - the intentions behind foundational design assumptions. Such (mis-)interpretation of the foundational rationale and justification is a recurring theme.
- The authors of remedial interventions, unless experienced, tend to over-design. They do not always have to work within the system, nor will they bear the impediment of burdensome or impractical rules. Moreover, designers and modifiers do not wish to be retrospectively blamed for deficient procedural design. For designers, detailed procedural specification is thus preferred. The very fact of comprehensive proceduralisation can thus become its own justification. This underlies a general management predisposition towards ever more self-defeating proceduralisation as a response to perceived system risk.
- Within every system a contingent daily logic of work practice emerges, supported by a social nexus which evolves in parallel. Locally developed norms emerge over time as operational practice repeatedly drifts towards acceptable (pragmatic) day-to-day work practices.
- Over time there is further *Procedural Drift* due to changes of senior personnel, new management philosophies and the input of different supervisory sub-groups. This drift is accentuated when new personnel are unaware of the underlying rationale and assumptions in original system development. As a result, and as is evidenced below, actions in direct contradiction of the original design philosophy can actually be incorporated into the system by well-meaning supervisors.
- There is also an impetus to *Procedural Drift* occasioned by the impact of different cycles of recruitment, training and organisational change, as

well as the distinctive internal political and bureaucratic processes that typify a wide range of organisational cultures.

- *Procedural Drift* can also be seen to issue from a loss of global focus, from failures of leadership or from confusion regarding the relative importance of different organisational production goals – such as operational, safety and efficiency goals. For example, procedures introduced for safety reasons may give rise to disproportionate operational inefficiencies (and vice versa).
- *Procedural Drift* has two primary organizational foci: one is the operational "front line", while the other is within the management "front line", namely independent supervisory sub-units having distinct commercial, efficiency or safety goals. Both foci can be considered as "local" in relation to the global or strategic design intentions that underlie original system design and objectives.

Snook (2000, P 197) observes that:

> *The net effect of this practical drift is a **general loosening of globally defined rationality.** Gone is the tightly logical and synchronized rationale that governed system design and rule production at birth. In its place are **multiple incrementally emergent sets of procedures**, each born out of unique subunit logics grounded in the separate day-to-day pragmatics of loosely coupled worlds. Gone is the single rationally designed "engineered world" governed by intricate sets of global rules. In its place is an "applied" world where locally pragmatic responses to the intimate demands of the task dictate action. Such applied solutions to real-world demands steadily drive out what appear to local practitioners as ill-conceived design deficiencies. Over time, the globally engineered, standardized organization is replaced by a series of locally adaptive subunit logics, each justifying their own version of "the rules*". [Emphasis added].

The Challenge

The foregoing presents the challenge for those who design procedures, checklists and other formal means of system protection. Trade-offs between operational realities, procedural content and consistency are inevitable. The best design comes from those with a global understanding of foundational system design and the weakness to be addressed through procedures but who, by virtue of having a good understanding of the realities of applied circumstances, can optimise solutions that will address incompatible demands. Such practitioners find solutions that are not always fully consistent at the margin. The best practitioners in this domain therefore practice an art rather than a fully specified and rational "procedural science".

At a more mundane level any management team faced with the conflicts discussed here will readily testify as to the difficulties and long debates associated with procedural development and implementation. Few doubt the sincerity and well-intentioned efforts of management in complex socio-technical organisations. It nonetheless remains a fact that procedural change is frequently problematic and that front-line personnel can find the justification and rationale behind procedural change hard to reconcile with their day-to-day operational experience. This statement is <u>not</u> intended to take any particular position as to whether front-line personnel are either right or wrong in their perceptions - given that operational inertia and conservatism provide as much grounds for resistance to change as does rational argument. In other words resistance to change itself tells us nothing. Indeed, it too merits careful scrutiny.

Arguments for and against procedural change are not, in practice, easy to assess, particularly in the absence of a clear understanding of core strategic system objectives. Even a cursory familiarity with procedural design will testify that this is an area needing much more study. Notwithstanding the presence of common terminology, there are wide variations between airlines and especially between different regions of the world. Surprisingly, the word "procedures" even has different meanings and uses, depending upon the airline or geographical region. Moreover, distinctions are often made between variants such as *Standard Operating Procedures*, *Recommended Operating Procedures* and *Normal Operating Procedures*. Some airlines aspire to mandatory, highly detailed and inflexible procedures while others are satisfied with a minimal core of inflexible procedures that are only changed after long deliberation. A definitive treatment is beyond the scope of this paper. Readers are cautioned to consider the following examples as illustrative of the complexity of *Procedural Drift* and not as definitive. They aim to demonstrate why we must better understand the phenomenon and its diverse manifestations, as well as its unpredictable genesis.

Selected Examples of *Procedural Drift*

1. Verbal Augmentation of Checklist Responses. By way of introduction, consider the following replies (adapted from actual responses) to the item "Flaps" in an aircraft Taxi Checklist. The first of these responses is that nominated in the aircraft checklist.

- Flap 6
- 6 selected and indicated
- 6 selected, indicated, leading edge
- 6 selected, indicated, in the detent, leading edge
- 6 selected, indicated and in the detent, leading edge, greens overhead
- 6 selected, indicated and in the detent, leading edge, 2&5 greens overhead
- 6 selected, in the FMC, indicated, in the detent, leading edge, 2&5 greens overhead
- 6 selected, in the FMC, indicated, in the detent, leading edge, 2&5 greens overhead, performance 6

The last response confirms that Flap 6 is selected, is entered in the flight management computer and that the Flap Lever is in the correct flap detent; that lights for the leading edge devices are illuminated; that flap 6 is indicated on the gauge and that green lights for the leading edge devices are as expected for the flap setting. The pilot finally states that runway take-off performance calculations are based on Flap 6.

Clearly there is *Procedural Drift* here, in the form of sequential additions to the formal checklist response. An extended discussion as to the merits of different responses is superfluous here. However, is it not appropriate to ask if the "proper" response (the first on the list) is actually inadequate? Or should one consider that a long and detailed response is, in itself, a good thing? How and where does one draw the line? Does it just represent a failure of standards or quality control? Or is this a more complex matter?

2. Reforming Zeal. Few pilots have not felt that they could radically improve some aspect of their airline's procedures. If they become managers and have an opportunity to do so, realities come to bear and they invariably face unanticipated practical objections and considered opposition from colleagues. However, from time to time an individual management pilot can successfully pursue a strongly held, but ill-advised point of view, against all objections.

For example, some years ago a safety reporting system received reports from pilots complaining about the unwillingness of airline management to listen to the chorus of adverse pilot reaction to a new Landing Checklist. Pilots appealed for action to be taken in response to the dangers of the new checklist, and management inflexibility. A management pilot had observed that the Landing Checklist on this aircraft type was, in actual practice, completed in a manner that approximated to three distinct phases. S/he decided that it would be better to formally split the Landing Checklist into three parts and move items that could be completed early into the first part, whilst late completion items such as flaps could be left in the third part. Judged in the abstract the *logic* of this approach, and the objective of ensuring that each part was fully completed *as a single unit* of cockpit activity, is not as unreasonable as this brief summary may make it appear. Certainly the manager was not trying to make things worse. S/he was merely seeking consistency and closure. But s/he did so in pursuit of a narrow goal that did not take cognisance of traditional/manufacturer checklist design, the previous operational experience of most pilots and established industry practice.

Pilots complained that the ensuing operational reality was far from that intended. They reported instances of confusion as to their position in the checklist and occasions on which items on the checklist were improperly completed or unintentionally omitted. In essence, an established routine of airline pilot practice had been discommoded so decisively that manifest risk had been introduced in the system. This was the paradoxical outcome of an act actually intended to reduce the risk of an uncompleted checklist. The consequences of Practical Drift are rarely seen in such sharp relief.

3. Seeking Excessive Consistency. Inter-fleet consistency is a highly desirable objective within airlines, for important and valid reasons. However, striving for consistency can have unintentional and disproportionate effects when consistency *itself* becomes the driving objective. The following example illustrates the consequences of failing to take a strategic and balanced view of procedural change, particularly to the extent that consistency over-rides other considerations – to the extent that practical drift is unintentionally encouraged.

Consider an airline with aircraft from three different manufacturers and generations, each with differences in operating philosophy. If two of these are relatively modern then the after take-off check will accomplished sometime after take-off by the non-flying pilot. The non-flying pilot will verbalise the check, but s/he alone will verify the completion of relevant items. Typically the check ends with both pilots checking their altimeters, this being the one item that is jointly verbalised and crosschecked. The overall objective here is to reduce opportunities for distraction and manage the flying pilot's workload. However, there is also an older generation aircraft type which has a "challenge and response" after take-off checklist. The checklist thus requires the active involvement of both pilots. In an attempt to achieve inter-fleet consistency, it is determined that all fleets should follow the challenge and response checklist philosophy. However, the requirement for a "challenge and response" checklist on the other two types runs contrary to the design philosophy and checklists produced by the two manufacturers. More importantly, the new philosophy is now introduced on types with a much higher level of aircraft performance (rate of climb, acceleration, etc). The effect of the new standardisation is thus to introduce an avoidable source of distraction and workload on the high performance aircraft types.

In operational practice line pilots periodically encounter operational distractions, as identified by the original research that first suggested the need for non-challenge and response after-take off checks. Moreover, since these aircraft were first operated for many years using a silent checklist, it is no surprise that further *Procedural Drift* occurs (simply by pilots reverting to previous behaviour and co-pilots responding flexibly to variable captain practices).

This is a point of departure for a "dual reality" in which pilots sometimes have a performance standard for normal operations and another for formal events such as checks. It was partly in response to the issues raised by such dual realities that Degani and Weiner (1994) added a forth "P", *Practices,* to their "3Ps", *Philosophy, Policy, Procedures.* Degani and Weiner acknowledged the need for a two-way assessment of procedural non-compliance, noting that both line practices *and* operational procedures merit attention.

4. Procedural Drift and Management Decisions. The following exemplifies how *interpretations* by pilots can err if pilots do not understand the underlying assumptions, intentions and objectives. In some circumstances terrain or obstacles can affect aircraft performance after an engine failure in the take-off phase. Procedures vary from airline to airline, but typically involved a mandatory turn to avoid the obstacle. In the following example superfluous detail has been removed so as to capture the essentials.

Typically the kind of information provided to pilots is as outlined in the first four lines of the box at the top of the next column. As part of training for new pilots it was suggested that a line be added to the procedure, namely: ***For Information*: Sector Safety Height 2,300 Feet**. The objective of this change was to encourage trainees to immediately consider safety heights after non-normal events. In the belief that it was inappropriate to expect pilots to consult a second chart at a time of high stress/workload, all relevant information was now provided on a single page.

ENGINE FAILURE ON TAKE-OFF
Maintain Runway Heading for 90 seconds
Turn left heading 160 º
Minimum Clean Up Height 600 Feet
Climb to 1,500 Feet: contact ATC
***For Information*:** Sector Safety Height 2,300 Ft

The foregoing explains the thinking behind this initiative. Management assessed the proposal and, unexpectedly, approved the change for both training and normal operational documentation. However they changed the wording in an apparently innocuous way, removing the words "*For Information*". It was pointed out that the addition of "Sector Safety Height *XXXX* feet" without explanation would generate questions from pilots (and answers from instructors). It was also noted that thus would introduce the risk that instructors would interpret what was meant and that this *information* might take on a life of its own and be reified into a procedural *requirement* to climb to the safety height. This point of view was rejected, but within five years the climb had indeed become a "requirement" in the minds of most pilots. A new "procedure", and allied training, had thus been introduced in circumstances where no explicit decision to do so had been taken by *anyone.* Furthermore, not all pilots and instructors shared the same conception of this procedure. This outcome is not as unique as it may appear - it just happens to be a particularly good example of processes that underlie a particular type of *Procedural Drift.*

When the information first appeared some pilots asked instructors and Check Airmen if this now meant that they should climb to their Sector Safety Height. Few instructors knew of the rationale and some replied in the negative, while some *interpreted* the information to mean that a climb to the Safety Height was now required once all drills had been completed. Over time a consensus developed, without any written guidance ever being issued, and many instructors conformed to this new consensus. In actual training practice nothing much changed, since practice drills in the simulator never got to the stage of actually climbing to the Sector Safety Height.

This is an appropriate example of *Procedural Drift* given that this matter is, in the grand scale of things, insignificant. Yet, in exceptional circumstances it could lead to an unfortunate event. The subsequent investigation might identify the *Procedural Drift* discussed above. Someone putatively "caused" this error, but to what, or to whom, would one address responsibility and a "Probable Cause" finding? The possible answers to this question would at least suggest some different focus points for research.

Concluding Examples

This section briefly examples of *Procedural Drift* identified during research for this paper, but which cannot be discussed in detail due to space constraints.

1. Modifying Established Systems. It was rapidly understood in the early days of aviation that pilots might pass all formal competency checks but be unable to conduct acceptable operations on normal passenger flights. It was in this context that the idea of a "Line Check" gained acceptance. The purpose of this annual check is to verify that all normal line operations are conducted in an acceptable manner. It is thus a "low key" quality check of "normality".

However it occasionally happens that Check Airmen become rather disillusioned with observing an often boring and uneventful normal day-to-day operation. They are also conscious of the fact that some flights are particularly undemanding, given the absence operational challenges. In this context some Check Airmen may choose to introduce an artificial "challenge" into the Line Check. For the purposes of the current discussion the issue of note is that a well-established airline practice is being changed here to the extent that an avoidable measure of risk - a latent failure - is being *intentionally* introduced. This serves to emphasise that the very evaluation of the merits of such actions can become, or reflect, the problematic. It also shows that what is considered by supervisory and check pilots in one organisation to be wise and sensible may be considered differently elsewhere.

2. Procedural over-specification. Crew briefings were originally introduced to assure crew co-ordination and shared expectations. Over time formal crew briefing requirements have grown considerably. For example, an arrival briefing might well have to address more than forty different items. There is a consequent danger that talking can itself become more important than crew coordination and the communication of essential information. Certainly the degree of *required* briefing detail varies considerably from airline to airline. There is insufficient space here to explore *Procedural Drift* in this domain beyond making some general comments. It is well identified that front-line employees tend to ignore, or modify, what they perceive to be over-specified, unwieldy or impractical procedures. Clearly, the longer the list of "mandatory" items to be completed the greater the likelihood of *Procedural Drift*. Drift also appears to be more common in repetitive short-haul operations than in long-haul operations. The evidence also suggests that a range of different considerations now drive the "growth" in briefing requirements and it is evident that the many justifications for this trend merit explicit evaluation.

3. Written Records. The requirement for written records seems to be another area in which *Procedural Drift* and confusion as to objectives can occur. It would appear that when "writing down" becomes more important than the information itself, counter-intuitive anomalies arise. For example, is it more important to write down a new transponder code, or a new ATC frequency, than to dial it up on the relevant avionics equipment? Arguments, and their underlying assumptions, as to the correct priorities here are instructive. At a minimum it seems to have been forgotten that the dual-frequency selector box that preserves the *current* frequency, whilst permitting the simultaneous tuning of the *next* frequency, was introduced to address the workload demand associated with writing down the frequency. This example is again trivial, but it provides a point of entry to clarifying the range of thinking behind airline procedures and pilot operational behaviours.

Issues and Implications

The examples above summarise *the* problem of *Procedural Drift* - which is the fact that apparently minor matters become latent systemic failures, even if they might only impact adversely by becoming part of a unique constellation of improbable events. However, this cannot be an argument for inaction. The fact that management and front line personnel actively create and deal with numerous latent failures cannot be simply ignored in a system that is striving for a quantum reduction in system vulnerability.

But there is more to this phenomenon. Just as LOSA reports suggest that checklist protocol deviations are a major issue in flight operations, when we look at a wider canvas it is clear that for as long as studies have been conducted, various types of non-compliance have been repetitively identified across a range of high-risk activities, from aviation to medicine. For example, in respect of aviation maintenance, McDonald *et al* (2000) conclude that:

> *One of the starkest conclusions from this research is that in fundamentally important respects the systems for ensuring safety and reliability in aircraft maintenance do not work*

as they are supposed to do. In so far as they do work as effective systems, this appears to be because of unofficial and informal mechanisms which are neither recognised nor valued in the way in which the systems are commonly understood by those responsible for them. In many ways these informal mechanisms run directly counter to the expressed goals and values of such systems …Violations of the formal procedures of work are admitted to occur in … one third of maintenance tasks. While it is possible to show that violations of procedures are involved in many safety events, many violations of procedures are not, and indeed some violations (strictly interpreted) appear to represent more effective ways of working.

People who are careless or incompetent do not create this dual reality. On the contrary, the research suggests that the best-motivated workers frequently feel obliged to resolve the tension between practical task demands and procedural inconsistency. In fact, resolving the tension between formal procedures and actual work practices seems to occur across a wide range of work tasks involving both complexity and socio-technical systems.

Conclusion

It is unclear how significant *Procedural Drift* is to aviation safety. As the examples illustrate, it is easy to consider *Procedural Drift* as a manifestation of management's failure to manage, or of a failure by front-line employees to adhere to job requirements. It could be argued that the consequences are trivial. There is, however, enough evidence to suggest that perhaps there is more to this phenomenon than mere triviality. It certainly merits a program of research.

The issue of management control, assessment and monitoring of procedural change will be relevant to such research. In this regard the relative stability of procedures in larger carriers bears comparison with the more regular procedural change in some smaller carriers. Nonetheless, it is equally clear that some long-established carriers tend to have a more "turgid" and inflexible operation than the new generation of "low cost" carriers. What is at question here are issues relating to management's global focus, control and balance in assessing the inevitable trade-off between competing safety, efficiency and other demands. There is also a paradox to be resolved, to the extent that the very rules intended to *reduce* variability often *create* unexpected variability. This is accentuated by responses to complexity that result in adding yet more complexity, whether in the form of more rules, procedures or layers of control. These, paradoxically, may reduce rather than contribute to system safety. Such paradoxes may be resolved by careful consideration of differences between *standardisation*, *proceduralisation* and *obligatory rules*, particularly as these relate to both tightly and loosely coupled operational systems (Lintern, 2003).

At a more philosophical level we face the challenge of coming to a better contextual understanding of what words such as "violation" and "error" *mean*. To properly understand *Procedural Drift* we also need a principled method of examining actions, intentions and understanding as "*meaning-making in context*".

Such considerations provide the research challenge. Solutions are likely (a) to successfully align global rationality and local rationality in some principled way, and (b) to do this in explicit recognition that *no* system, not to mention socio-technical systems, is fully specifiable (Lintern, *op. cit.*). Developing procedural design principles, or basic "rules of thumb" for managers, including methods of quality control would be advantageous. Moreover, managers will manifestly benefit from research that provides both practical guidance and training guidelines.

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