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Dr Andrew Cook
Graham Tanner

Attitudes to Societal Demands in ATM Operations

Introduction of a B-CDA trial at Manchester Airport

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Dr Andrew Cook
Graham Tanner
Transport Study Group
University of Westminster
London, UK
airspace-research@westminster.ac.uk

with
Nadine Pilon nadine.pilon@eurocontrol.int
EUROCONTROL EXPERIMENTAL CENTRE, Bretigny sur Orge, France

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EXECUTIVE SUMMARY

This Study seeks to improve the understanding of attitudes to change in ATM. In particular, it will examine the interconnectivities and dependencies between change in ATM and both the societal impact of such change, and societal influences on such change: these interactions may be two-way processes.

The Study is designed to be generic in its approach and will be based on a number of case studies. It is planned that some of these case studies will be similar, focusing on the same type of change, and others will be different. As new cases are added to the programme, the scope of ATM change will be understood more broadly, and the assessment framework being developed will evolve in the light of new examples. The Study will also attempt to delineate the barriers to, and drivers of, change in ATM, within the societal context, for example: how directly and how intensely do ATC personnel and pilots feel community pressure and through what processes?

This Report explains the overall approach of the Study, and presents the results of the first case study – the introduction of a night-time Basic Continuous Descent Approach (henceforth "CDA") trial, at Manchester Airport. It is planned that two further CDA trials will be added to the Study in 2006.

Some changes in ATM may be driven by factors in a 'top-down' manner, for example the Single European Sky initiative. Other changes may be driven in a 'bottom-up' manner, e.g. noise reductions at an airport, demanded by local residents. Considering ATM change at the highest level, a library of generic questions has been generated relating to such change. It is anticipated that this library may be added to during the course of the Study, as different case studies are added, and that this library will form a key part of the final output.

To inform this process, the University of Westminster has used its Seven Stages of Change model (as previously developed for the EU's TAPESTRY project) for measuring change. This model draws on the Theory of Planned Behaviour. The model stresses, for example, that changes in attitude can be brought about regarding the *importance* of elements of change to people (e.g. "I think it is very important to control noise levels"), the *perception* of elements (e.g. "But I think noise levels here are very low") and the respondent's perceived *responsibility* for the element (e.g. "But noise levels are nothing to do with me anyway").

Applying this methodology, face-to-face interviews were carried out in Manchester between 07 and 09 March 2005 with controllers, and managerial / training captains from each of the three airlines participating in the Manchester CDA trial. The close-out for return of the self-completion components of these questionnaires, and for questionnaires from line pilots, was 18 April 2005. In total, 41 interviews were finally included (after a small number of exclusions).

The questionnaires and interviews indicated that pilot and controller concerns about noise levels in particular, and about the societal impacts of ATM, were overall very low. Whilst safety was of paramount importance across the whole respondent base, the economies of fuel saving (in particular) and the 'professionalism' (e.g. increased passenger comfort) of CDAs were also important to pilots. It can be said that generally, to the extent that CDAs were compatible with existing priorities of pilots and controllers, they were accepted by both sets of respondents. This was tempered somewhat by actual annoyance by some respondents that noise issues near airports received such a high profile.

The Seven Stages of Change model, and the generic questions developed in this Study, were designed to enable a differentiation to be made (where possible) between organisational-level questions (taking a strategic view) and asking about personal actions (e.g. tactical decisions). Although CDAs are enabled by the infrastructure, each successful CDA needs appropriate pilot-controller interaction and motivation.

The prompt to adopt a particular course of action may be determined by a macro-level objective (e.g. to increase capacity at a European level), or by a micro-level objective (e.g. to reduce noise complaints at a specific airport). Strategic trade-offs can be made for both macro-level and micro-level objectives, whereas tactical trade-offs are mostly made in the context of micro-level objectives. This Report suggests that there is some deferment of social responsibility from pilots and controllers to the 'system', as established at the strategic level, in which the Airport may play a special rôle. This is a particularly interesting concept to explore further in future case studies.

At the strategic level both NATS management and the Environment Department at Manchester Airport concurred that the introduction of the CDA trial at Manchester was set in the context of a move across Europe of focusing more on arrival noise, a move which had earlier included UK CAA consultation with the airlines. The trial was not introduced in the context of any increase in noise complaints, i.e. not driven by societal pressure *per se*. Much effort had already been invested in departure noise control mechanisms – where room for improvement was thus viewed now as more limited. Notwithstanding this observation, at the tactical level (with pilots and controllers) there was some (qualitative) evidence from the survey for a somewhat persistent 'departures culture'.

A wide range of operational issues was raised by interviewees, relating to the broader context of CDAs in terms of their physical extent; predictability; procedural standardisation; restrictedness due to local airspace / terrain; workload issues and track updates; plus pilot concern about possible rushed / missed approaches.

There is a natural human tendency to complain rather than praise, such that survey summary data, based on scalar questions can be more representative of the 'norm' than illustrative quotations. It is therefore important to consider some of the qualitative comments made in the light of corresponding (semi-)quantitative findings.

The Seven Stages of Change model also stresses the importance of asking questions relating to experiential cycles, i.e. how attitudes to particular changes (in ATM) are modified according to experience. Only one respondent in the whole sample indicated any reduced support as the trial progressed; some pilots and controllers saw the CDA trial as a progression towards something better. It is hoped that an update to this Report may be provided in subsequent reporting, to look at further progress at Manchester, and any initiatives following the CDA trial - in particular any further implementation of CDAs and how this is managed at the organisational and individual levels.

Several (mostly simplifying) changes are proposed to the Manchester questionnaire, to better suit the context of the next planned case studies: looking at CDA trials at Arlanda (Stockholm) and Henri Coanda International (Bucharest) airports. Together with Manchester, these next case studies will not only form an interesting collection in terms of the varying societal contexts, but also operationally, as the Manchester method is radar-only, Bucharest is STAR-only, and Stockholm is to be a mixture of RNAV STAR (during lower traffic volumes) or vectoring (when traffic volumes are higher).

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TITLE:

Attitudes to Societal Demands in ATM Operations
Introduction of a B-CDA trial at Manchester Airport (Edition 3)

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Dr Andrew Cook Graham Tanner (Transport Studies Group University of Westminster) EEC Contact : Nadine Pilon	12/05	vii + 62	4	14	6	0

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Abstract:
This Study seeks to improve the understanding of attitudes to change in ATM. It attempts to delineate the barriers to, and drivers of, such change, within the societal context. For example: how directly and how intensely do ATC personnel and pilots feel community pressure and through what processes? The Study is generic in its approach and will be based on a number of case studies. The need is identified to assess attitude to change at both the organisational and individual levels, for both macro-level and micro-level objectives. This Report details the methodology and presents the results of the first case study - the introduction of a night-time Basic Continuous Descent Approach trial at Manchester Airport.

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1. INTRODUCTION

This Study seeks to improve the understanding of attitudes to change in ATM. In particular, it will examine the interconnectivities and dependencies between change in ATM and both the societal impact of such change, and societal influences on such change: these interactions may be two-way processes.

The Study is designed to be generic in its approach to the investigation of change in ATM, and will be based on a number of case studies. It is planned that some of these case studies will be similar, focusing on the same type of change, and others will be different. As new cases are added to the programme, the scope of such change will be understood more broadly, and the assessment framework being developed will evolve in the light of new examples.

This Report explains the overall approach to the Study, and presents the results of the first case study – the introduction of a night-time Basic Continuous Descent Approach (henceforth "CDA") trial, at Manchester Airport. It is planned that two further CDA trials will be added to the Study in 2006 (see Section 4).

1.1 Review of Study objectives and methodology applied

Demand on European airspace is ever increasing, to the point whereby the delivery of additional capacity can only be achieved by significant changes in the way ATM functions. However, these changes need to be brought about in a sustainable manner that not only focuses on the environment (e.g. in terms of managing air and noise pollution), but also applies to (new) technologies, working practices and the *people* involved in such change – people within the ATM industry, and society in the broader sense.

Many of the airspace structures in place today were designed at a time when noise and fuel burn were not priority concerns. During later periods of intense growth in air traffic, changes in airspace structures have often been brought about in order to accommodate air traffic demand. More recently, however, greater emphasis has been placed on achieving greater airspace capacity in a more sustainable manner, although starting from a less than ideal position. This means that there are a variety of pressures from both the ATM community and 'society', driving such change forward, as well as inhibiting such change.

The central remit of this Study is to understand how sustainable change can be brought about within the context of societal demand: what are the barriers to such change? What are the drivers of such change?

Drivers of change can be split into two broad categories:

- stakeholder influence
- technology, process and infrastructure

Even at this high level, such drivers of change are often interconnected. For example, a new process or technology will require stakeholder influence to bring about its introduction. However, the detail of a change, the way in which it is operationally implemented, is primarily driven either by a stakeholder influence, or a new process or technology.

These broad categories can be further divided:

- stakeholder influence
    - professional
        - e.g. organisation and ‘culture’
          - e.g. Eurocontrol
    - society
        - e.g. local authorities

- technology, process and structure
    - technology
        - e.g. equipment
    - process
        - e.g. training
    - infrastructure
        - e.g. airspace constraints

Some changes may be driven by factors in a ‘top-down’ manner, for example the Single European Sky initiative driven by Eurocontrol. Other changes may be driven in a ‘bottom-up’ manner, e.g. noise reductions at an airport, demanded by local residents.

Whilst some changes can be brought about with quite a tight focus in one particular area (e.g. a change in a standing agreement between two adjacent ATC sectors), other changes such as the Single European Sky initiative, will have wide implications across many categories of change.

These descriptions of categories are not designed to be either prescriptive or restrictive ways of thinking about change, but rather to help think about change in a systematic way. This means that important considerations are taken into account when trying to measure and understand change.

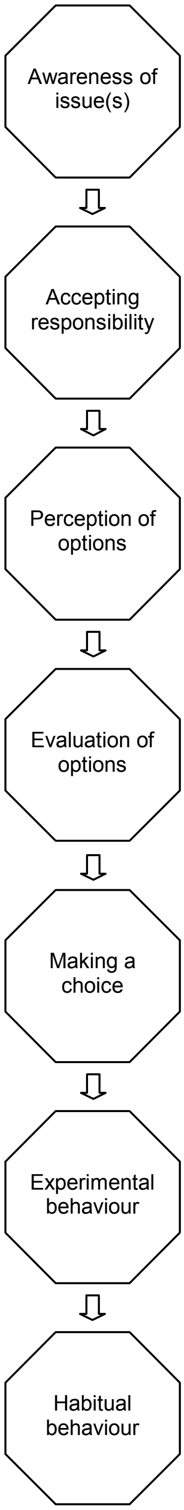
The core focus of the Study definition, as defined by EEC, was to assess:

how directly and how intensely ATC personnel feel community pressure and through what processes

As part of the earlier development of the methodology to address this question, the University of Westminster proposed to use its Seven Stages of Change model, as previously developed for the EU’s TAPESTRY project, as a vehicle for understanding how changes towards sustainable transport behaviour can be brought about, and, indeed, by understanding the stages involved, for developing a framework for measuring progress towards such change. The model is illustrated in Figure 1.

Figure 1 - Seven Stages of Change model

(with example questions based on CDA)



e.g. are there existing, perceived problems of noise?

e.g. does a controller see the use of CDA procedures as their own responsibility, or should it be left to others to decide?

e.g. how are the alternatives to CDA viewed by a pilot? How is controller's perception influenced - by perceived views/endorsement of ATC managers? - by societal pressure?

e.g. what factors, in addition to safety, are prioritised? Are CDAs considered to be: - worthwhile? - safe? - desirable? - capacity limiting? - time-consuming?

e.g. what governs decision-making on a flight-by-flight basis?

e.g. how does 'experimental behaviour' (such as participation in trials, first use of CDA) relate to: - previous perceptions? - evaluations? - actual decision-making?

e.g. has experimental behaviour increased or decreased the propensity to support CDA procedures? What are the barriers to, and opportunities for, continued and increased implementation?

As also illustrated in Figure 1, it is important to ask questions relating to experiential cycles, i.e. how attitudes to particular changes in ATM are modified according to experience. It is thus also important to set answers to surveys in the context of the stage at which the particular process of change was in, and to try to compare like with like across different case studies (e.g. interviewing pilots and controllers about CDA trials at approximately the same point in the trials, as far as possible).

Changes in attitude can be brought about regarding the *importance* of elements to people (e.g. "I think it is very important to control noise levels"), the *perception* of elements (e.g. "But I think noise levels here are very low") and the respondent's perceived *responsibility* for the element (e.g. "But noise levels are nothing to do with me anyway"). These attitudes need to be understood together – knowing that controllers all consider noise levels to be important is put into a much more useful context if it also known that those same controllers did not think noise levels were their responsibility, were of minimal importance compared to safety, were determined by others at the strategic level of decision making, or that aircraft approach noise was in any case very low, for example.

Fundamentally, it is also important to differentiate between <u>organisational</u> questions (taking a <u>strategic</u> view) and asking about <u>personal</u> actions (e.g. <u>tactical</u> decisions). An example would be asking a NATS manager about the 'corporate', 'organisational' view of CDAs, and asking controllers about the practicalities of tactical implementation (e.g. having to abandon CDAs during very high workloads). Although it is possible to mix these questions with interviewees to some extent, it is better to target particular types of questions to the same interviewee. Questions should be appropriate to interviewee job specification and areas of responsibility.

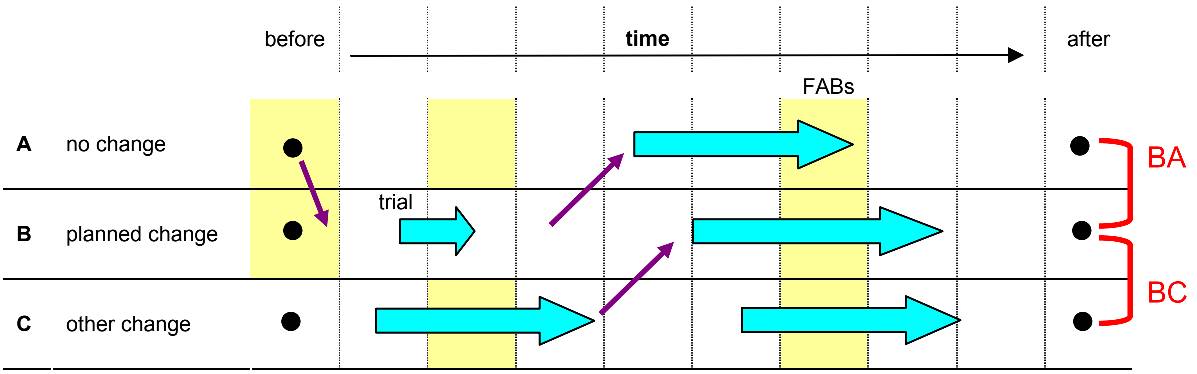
For each change investigated, the following key questions should be raised and answered, as far as possible:

- How do societal demands contribute to the drive for change?
- At what levels are the drivers?
    - stakeholder – professional / societal? individual / organisational?
    - due to technology / process / infrastructure?
- What changes / tools are required to remove / reduce barriers?

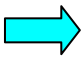
Figure 2 is a general scheme showing processes of change in ATM, against a horizontal axis of time. Imagine that there are three different courses of action: A (no change planned), B (some specific change planned, such as the introduction of CDA) and C (some other change, different from B).

This Study is about understanding change in ATM, focusing in turn on different types of change. For example, one case study might be the introduction of CDA, another might be the automation of a previously manual flow management process. In each case study, course 'B' is the planned change under consideration. The available options to decision makers when considering course B may be simplified as doing 'nothing' (A), or doing 'something else' (C).

Figure 2 - Scheme showing change in ATM



Key

	process of ATM change specific to chosen course of action	e.g. introduction of CDA
	period of events driving generic ATM change ('context' of change)	e.g. Single Sky implementation
	decision to adopt a different type of ATM change	e.g. decision to move from no change, to a CDA trial

Even the course of 'no change' (A) will, sooner or later, involve some sort of ATM change being implemented. No ATM system remains static in the context of ever increasing demands on capacity, and cost pressures. Hence even course A has an arrow downstream showing some sort of specific change.

During time, various events will occur which may have particular consequences for particular courses of action chosen. These are represented by yellow shading. Consider the vertical shading on the right-hand side of the diagram. This could represent a particular phase of the on-going implementation of the Single Sky initiative, such as the introduction of Functional Airspace Blocks. Such a change could have an effect on all courses of action: A, B and C, in some way or another.

Some other generic change, such as national legislation further reducing permitted emissions, might have direct consequences for the 'no change' course of action (e.g. because this legislation had not been anticipated) or might have no effect on the planned action B (e.g. because it already included sufficient plans for reducing emissions).

For this reason, some of the yellow shading, representing general, background change in ATM (the broader 'context' of change), are not shaded in full strips down every column, because interactions with certain courses of action (A, B or C) may be very weak.

The arrows indicate a change in decision making, to move from one course of action, to another. For example, in the before situation under the 'no change' course of action, the yellow shading of the context might represent a background of severe complaints from the public regarding noise, which might encourage the local ATM community to move in the direction of setting up CDA trials (say, 'B').

Although Figure 2 is clearly a simplified representation of the process of ATM change, it is helpful in offering a visual representation of the fuller scope of ATM change, and how different courses of action may be compared. This somewhat theoretical, figurative representation will help to define a broad context for a set of completely generic questions about change in ATM. From these generic questions, specific questions about a particular type of change may be devised (see Table 3, later).

Using this method of creating questions, questions which are generic by nature, and thus vertically integrated across different phases of the Study, are automatically generated. By producing such questions from a broad, figurative model, it is possible to set such questions into a broad context, thus avoiding the problem of being too 'blinkered' by the specifics of any *particular* change in ATM. This more generic question base thus allows better comparisons to be made across different types of change in ATM.

It is also clear that different courses of action will result in different (anticipated) outcomes. A planned course of action may be chosen to *avoid* particular outcomes (especially those which might result from no change), or to achieve particular outcomes from the planned course of action. The trigger to adopt such courses of action may be set by a **macro-level objective** (e.g. to increase capacity at a European level), or by a more **micro-level objective** (e.g. to reduce noise complaints at a specific airport).

Before the planned course of action is adopted, the trade-offs between doing 'nothing' (BA) and adopting a different course of action altogether (BC) will usually be considered. These may be termed **strategic trade-offs**.

Having decided upon a particular course of action, and having fully implemented it, there may still exist **tactical trade-offs**, during the actual operational practice of the new methods or procedures. For example, a CDA approach, fully endorsed at the strategic level, may be ignored for a given tactical instance, due to other overriding demands (typically those of capacity considerations).

Strategic trade-offs can be made for both macro-level and micro-level objectives, whereas tactical trade-offs are mostly made in the context of micro-level objectives.

Table 1 - Level of objectives versus trade-off levels

		level of objectives	
		micro	**macro**
level of trade-offs	**strategic**	✓	✓
	tactical	✓	*x*

A key focus of this project is to understand how pressures from society impact on these processes of change. Examples of these influences may be used to populate Table 1:

Table 2 - Level of objectives versus trade-off levels (more detail)

		level of objectives	
		micro	**macro**
level of trade-offs	**strategic**	building a new runway (public protest against airport development *versus* support to local economy from airport)	increase of European capacity (public demand for travel *versus* national / European legislation on air quality)
	tactical	CDA for flight ABC01 (public protest against noise in morning *versus* capacity constraint at 0800)	*x*

Whereas it is to be expected that (senior) management are more aware of the strategic level trade-offs, controllers and pilots might be expected to be more concerned with the tactical trade-offs (e.g. risking a noise complaint at 0800 in order to manage a surge in demand).

In Table 3, some of these concepts have been drawn together to generate a library of questions relating to change in ATM. It is anticipated that these may be added to during the course of the study, and form a key part of the final deliverable, for future reference.

It is to be noted that the questions are completely generic, in that they do not refer to any specific change in ATM (such as a CDA trial), but may be used to generate specific case-study questions. By this mechanism, it is hoped that the questions between study phases will be as **vertically integrated** as possible, by 'mapping back' to the generic concepts in Table 3.

Before presenting the actual table, it worth making some remarks on the terminology used in the table:

'Change' used in a general sense to describe either a specific procedure (e.g. CDA) or a more generic process of change, such as staff relocation.

When using the table to develop specific questionnaires, it is very important to appreciate the context of the interview, for both the interviewer and the interviewee. 'You' may refer either to the individual being interviewed, or to the corporate/authority point of view. In the context of tactical decision making and attitudes, e.g. when interviewing pilots and controllers, 'you' means the individual. In terms of the strategic context, e.g. when interviewing managers, 'you' refers to the point of view of the company or authority – i.e. the manager is being asked to be interviewed with the 'corporate hat on'. It will be valuable to be able to compare and contrast these perspectives, where possible.

Where the term 'problem' is used, this may refer specifically to a globally recognised problem, such as CO_2 emissions, or to a far more subjective or parochial issue such as noise levels, or to an issue such as staffing costs, causing a 'problem' to senior management in the context of a major cost-cutting exercise, but which controllers being forced to relocate to another ACC may not see as a 'problem' in the same sense at all.

Many terms used in questionnaires are subjective, and vary according to the point of view of the respondent, and it is very important to understand these factors, and to be sensitive to them in the context of the interview.

In terms of developing the generic questions, terms such as 'compliance' and 'failure' have been used to describe the achievement or fulfilment of change. These terms carry subjective overtones which are difficult to remove without making the language of describing the questions artificially laboured.

When turning these ideas into specific questions for questionnaires for interviews, however, it is important to remove as much of the emotive overtone and subjectivity as possible. For example, 'failure to achieve a CDA' might be simply replaced with 'stepped approach'.

This library of questions has been used to produce a specific questionnaire to be used for the investigation of the Manchester CDA trials (see Section 1.2).

Table 3 - Library of generic questions

<u>Conditions before change</u>
From what source first heard about (potential) change? Credibility of source? Attitude to source? Was change described accurately, or did this subsequently change? Were there any negative pre-conceptions, e.g. from peers, from other ANSPs? Information on success or failure of similar changes? Where? Sources of such information?
Disposition and condition of system before change. Key descriptors of disposition, in terms of: - capacity constraints - airspace structure - environmental constraints - cost-saving requirements - societal pressure
Was there a problem to fix, or a need for improvement? What was the specific, first trigger of change? Would the change eventually have occurred (in one way or another) in any case, without this trigger? What pressures were exerted to support the change? Against the change? Sources of such pressures? Which stakeholders? How exerted? Who benefits most from the change? Any quantitative evidence of benefit? Agree with objectives, or more accept as a trade-off for some other benefit?
Interface with public – what effect, if any, from interaction with public? How does such interaction work? Filtered?
Levels of approval required: - national / regulatory authority - local assessment (e.g. airport, local govt)
<u>Context of introduction</u>
By whom was final decision to adopt the change announced? Decision-making process to adopt change? How was change announced by higher-tier management – with endorsement? neutral? as necessity?

Timing of change c.f. other changes? Seen as lower / higher priority than would usually, due to other changes taking place / being discussed at same time. How did such other change(s) (if any) improve or worsen attitude to the change in question? Staff motivation? Technical compatibility?
Consultation and facilitation: For pilots and controllers - level of interest in change? Ownership? Personal responsibility? Facilitation of change - same as those exerting pressure for change? How well those exerting pressure understand process / able to facilitate it? Public consultation?
Level of <u>enforcement</u>?
Level of support: - supporting documentation / information - supporting training - supporting tools - supporting Could procedure be adapted, e.g. with more, or less, autonomy of decision making, to allow greater compliance / fulfilment? Would greater, or lesser, degree of 'systemisation' help?
Context of integration? Local / national (environmental) constraints?
<u>Alternative to change</u>
Considering the specific 'problem' the change was trying to address, what alternative changes were formally considered, if any? (Alternatives include either completely different types of change, or different ways of carrying out the actual change adopted). Why alternatives not adopted in end? Still any scope for such alternatives?
Consequence of taking <u>no action</u>? Unacceptable? To whom?
Were/are there any specific (anticipated) disadvantages of planned change?
Again considering the specific 'problem' the change was trying to address, to what extent was the adopted change the best way to address the 'problem'?
<u>Operational practice</u>

Is there a weakest link in the chain (e.g. failure to achieve certain interaction) or a common situation (e.g. nearing capacity overload) which results in failure to implement change / use new procedure? What are the causes of such failures / drivers of compliance? - (lack of) *awareness* of objectives? Case where improved awareness = increased acceptance / cooperation? - (lack of) *acceptance* of objectives? Why? - personal (de)motivation? Broader than specific objectives? Does membership of any committee / union / association change personal attitude to change, motivation to encompass change? - Pressure from line management? - Other pressures, such as societal?
Compare reasons for isolated, tactical failures (e.g. personal level), with more systemic, strategic failures (e.g. structural / corporate level)?
Any targets set? Realistic? Fair measurement of target? How do environmental procedures integrate with other performance targets, such as declared and achieved capacities? Conflicts of targets? Problems with poorly-specified / qualitative targets? Mechanism for reporting compliance failure? Credibility/ integrity of such mechanism? Does reporting mechanism fully and objectively reflect operational reality? Failure taken seriously? (Question only applies in non-safety critical contexts). What type/form of feedback given?
Consequence of failure for individual? Are 'failures' personally attributable?
Operational consequence of failure, by failure modes? Which failure mode preferred? Formally endorsed?
Safety impact of failure to comply? Are there any safety impacts of always complying? Workload? Weather? Any instances of actual / perceived compromise?
After the change (or introduction of trial etc)
To what extent, if any, has the change been accepted on its own merits? How have views changed, if at all, compared to before the change? For example, was a change introduced by senior management with doubtful benefits now seen as having merit in its own right? What key factors result in support for a change in ATM?
Is the process now complete? Is there a future a point at which it is felt the change will be better, or worse?
Key things advise another unit to do
Key things advise another unit not to do

1.2 Development of the Manchester questionnaire

Before selecting specific instances of the general ideas of Table 3, and translating them into a explicit questionnaire for the Manchester CDA trial (clearly it would not be possible to include all the question areas listed in Table 3, considering the time constraints imposed when interviewing controllers and pilots), three phases of development were carried out:

- November 2004: a technical interview with London Terminal Control Centre (LTCC), to obtain independent background information on the development of CDA trials in the UK, based on the initial trials at London Heathrow, and including a discussion of any problems which might be anticipated in transferring the 'Heathrow protocol' to Manchester, with an emphasis on the operational perspective of controllers

- December 2004: an interview with TAP's Chief Pilot at TAP headquarters in Lisbon, to gain an independent insight into the pros and cons of CDAs from the pilots' point of view, including a discussion of the comparison of cockpit workload for CDAs with other approaches (e.g. at London Heathrow)

- early March 2005: a limited opportunity for review of questionnaire by Eurocontrol, following which several useful amendments were made to the questionnaire

The primary objectives of the questionnaire developed for the Manchester field study (a copy of which is to be found in Technical Annex 1) were as follows:

- to be as generic as possible, thus covering both controllers and pilots, to allow as direct a comparison as possible between these two groups

- to be usable partly as an interviewer-administered questionnaire (Section B), and partly as a self-completion questionnaire (Section A). This is because it was estimated that for pilots or controllers, only approximately 15 - 20 minutes would be available for the interviewer-administered section (B), which, alone, is insufficient to capture the full range of responses required

- alternatively, to be usable *entirely* as a self-completion questionnaire (if required)

- to not generate 'prompt bias', i.e. not to allow the interviewee to detect that a core focus of the study is to understand societal demands. Instead, to a large extent, these demands must be elicited naturally and find their 'own place' in the responses given. Clearly, if all questions asked were about societal demand, the responses would give a very biased impression as to the importance of this issue, and the questionnaire would seem 'forced' to the interviewee, missing important points, and resulting in a loss of interviewee confidence and cooperation

- to capture the core questions of Table 3. If Section B was too detailed, and had to be rushed by the interviewer, its value would be diminished. If Section A was too long, it was less likely to be completed and returned by the interviewees – again, it is better to ask key questions well, than try to cover too much. This is one of the most difficult tasks facing the current data collection phase of the project, due to the quite severe limitations of interviewee time (which was appreciated in advance)

- to capture a good qualitative feel for the scope of the issues involved, enabling good illustrative quotations to be used at the reporting stage, whilst developing and testing some questions (particularly in Section A) which might be used in subsequent phases for a (shift towards a) more quantitative approach

By raising neutral questions relating to different stages and processes during the interview, not only will barriers be revealed in cases of lack of facilitation, but also opportunities, where support and facilitation already exist.

2. RESULTS OF THE MANCHESTER STUDY

2.1 Interviews and response rates

Face-to-face interviews were carried out in Manchester between 07 and 09 March 2005, by two University of Westminster researchers. A dedicated room was made available on-site by NATS, and controllers were released for interview as shift changes and traffic volumes permitted, on an *ad hoc* basis. These typically lasted about 15 minutes – controllers were taken through Section B of the questionnaire, and given Section A to return by post.

The second interviewer also met with three managerial / training captains from the airlines during this three day period, at pre-arranged appointments, carrying out more in-depth interviews, typically of about one hour in duration. Twenty questionnaires were left with each ‘AO manager’ to distribute amongst their line pilots (it was decided *in situ* that this was going to be a superior approach to attempted *ad hoc* interviews of pilots).

Two of the airlines initially returned quite low numbers of responses from such line pilots. After follow-up from the University of Westminster on 01 April 2005, the corresponding managers prompted line pilots to respond, and more responses followed, up until 18 April 2005. The final response distribution is shown below:

Table 4 - Response distribution

<table>
<tr><th>Interviewee</th><th>interviewed face-to-face with Section B</th><th>Section A returned by post</th><th>given postal questionnaire: Sections A & B</th><th>postal questionnaire returned</th></tr>
<tr><td>‘Line’ controllers</td><td>9</td><td>7</td><td colspan="2" rowspan="3">-</td></tr>
<tr><td>Other controllers</td><td>4</td><td>3</td></tr>
<tr><td>AO managers</td><td colspan="2">3/3 in-depth interviews</td></tr>
<tr><td>bmibaby line pilots</td><td colspan="2" rowspan="3">-</td><td>20</td><td>8</td></tr>
<tr><td>BA CitiExpress line pilots</td><td>20</td><td>11</td></tr>
<tr><td>Thomas Cook line pilots</td><td>20</td><td>7</td></tr>
<tr><td colspan="5">Total number of interviewees = 41*</td></tr>
</table>

* one AO manager also flew frequently into Manchester and thus also completed a questionnaire as a ‘line’ pilot, as well as participating in an in-depth interview, so the total number of interviewees is one less than adding up the numbers in the table implies

Of the 41 interviews, one controller worked day shifts only, and thus did not complete Section A (but other views and comments from the face-to-face interview, Section B, were admitted), and two controllers did not return Section A by post.

Two pilots did not complete Section A due to not having completed CDAs at Manchester, but felt qualified to comment on the more general aspects of Section B, since they were aware of the documentation and procedures (so their views were admitted). Three pilots did not complete Section A, but it was not possible to determine definitively why not.

Four pilots had not carried out CDAs at Manchester but still felt qualified to answer parts of Section A. These responses were admitted, since the Study is more about understanding attitudes to change, than exclusively focusing on issues at Manchester *per se*. Furthermore, these pilots appeared to be discerning as to which questions they elected to answer. One such pilot answered Question A03, however (relating to who usually initiates a CDA at Manchester), and another such pilot offered one strongly expressed response regarding a particular aspect of CDAs at Manchester. Both of these (item) responses were disallowed during the data analysis.

When reporting the results of Section A, which was designed to be somewhat more quantitative in scope than Section B (or at least to indicate what could be achieved through a more quantitative approach), the common sample size indication 'pilots (n=21)' and 'controllers (n=10)' is given in the tables, unless a significant departure from these figures resulted from a high (item) non-response rate. Base numbers in Section B should be assumed to be 41 respondents, although this section of the questionnaire has been treated more qualitatively. Due to the more qualitative nature of the approach overall, these sample sizes are to be used indicatively, rather than as bestowing 'significance' to particular results.

As mentioned in Section 1.2, interviewees were not told of the objectives of the Study, i.e. to discover societal impacts on change in ATM, so as not to bias their responses. This issue is dealt with again in Section 2.2.6, under 'CDAs and society'.

In some cases, full sentences quoted from interviewees addressed issues raised by more than one question in the questionnaire. To avoid splitting these sentences up into less intelligible fragments, such quotations have been repeated in full in more than one section of this Report, in isolated cases.

2.2 Results of the Manchester interviews

2.2.1 Introduction of CDAs – context and consultation

Both NATS management and the Environment Department at Manchester Airport concurred that the introduction of the CDA trial at Manchester was set in the context of a move across Europe of focusing more on arrival noise, a move which had earlier included UK CAA consultation with the airlines. Much effort had already been invested in departure noise control mechanisms – where room for improvement was thus viewed as more limited (see also Section 2.2.6). The trial was not introduced in the context of any increase in noise complaints at Manchester, i.e. not driven by societal pressure *per se*.

The reasons understood by the pilot and controller respondents for introducing the trial (in response to Question B01) were quite varied, many citing fuel savings and noise abatement, some controllers attributing the introduction of the trial *primarily* to a request by Eurocontrol, two controllers quoting a drive from the local authority owners of Manchester Airport, and one pilot[31] citing a need to 'improve traffic flows'.

Initial reactions were mostly positive, or neutral, across all respondents. No distinctly negative initial reactions were reported, although one controller was "suspicious" of how it would work, and one pilot was sceptical about the motivation, but still acknowledged (in responses to Questions B02 and B04) the environmental benefit accrued.

Many controllers had worked at other airports and were already familiar with the CDA concept. Several mentioned a recent FMS trial at Manchester, which, to some extent, carried somewhat negative overtones over into their initial reaction to the CDA trial:

> *Not another FMS trial – we had that 6 months ago, then heard nothing about it. When I thought about it, though, I thought it* [CDA] *would be good for noise reduction.* [2]

> *My reaction was neutral really – we try to do them in the day already* [3]

The initial reaction of the three AO managers interviewed was very positive, indeed reflected in a mostly positive response from line pilots, too, many saying that they already attempted CDAs wherever possible, including at Manchester, before the trial started. However, it was repeatedly stated by many pilots (and AO managers) that the CDA should start further out, that AOs consider CDAs as starting at ToD, as summarised by:

> *My reaction was ambivalent in that we try to achieve CDAs all the time as pilots. Also, it would be of more use if the CD could be coordinated from a higher level, i.e. we often fly level for long periods at 6000ft during approaches to Manchester. There is little change in the present format to most parties because the descent is not continuous from a high enough level and most operators can achieve it from 5-6000ft already, most of the time.* [10]

One controller[5] believed the trial was actually introduced for the purposes of procedural consistency, and several other controllers saw standardisation of procedure as a distinct advantage. In contrast, a further controller[12] stated that if “forced” to carry out CDAs, this could reduce the flexibility of quickly descending aircraft to maintain vertical separation, especially with the high terrain issue at Manchester, another[17] declaring that CDAs could reduce flexibility during higher traffic volumes. Terrain issues and airspace restrictions were frequently quoted by controllers as restrictive influences (see also Section 2.2.5).

In contrast to the more common controller statements to the effect that procedural standardisation was a positive effect, several pilots, and one of the AO managers, expressed concern that if the CDAs became *too* procedural (and extended to daytime operations), it may reduce flexibility, such as earlier turn-ons, straight-ins and visual approaches.

In terms of the consultation process, responses to Question A02 suggested that this was generally felt to be adequate as it stood, or not needed. Respondents citing a lack of consultation, and directly stating or implying that such should have taken place, were relatively rare. The AO managers felt that consultation at the strategic level was good.

This question could be enhanced in the next phase by even more explicitly asking respondents if they thought the consultation process should have been better and should have included them.

Although reactions were mixed in response to Question A06, the perceived balance of management endorsement seemed to be on the positive side, and lack of such support was not mentioned as a determining factor in not carrying out CDAs (Table A05). Indeed, reasons cited for not carrying out CDAs were quite varied, controllers and pilots each ‘blaming’ each other to some extent, with pilots somewhat more disposed to take the blame upon themselves, and controllers to ‘blame’ (traffic) workloads.

Table A05 - Reasons for not achieving CDAs

Concerning the night-time approaches at Manchester which are expected to be continuous descents, in cases where these are <u>not</u> achieved, what would you say are the most common reasons for not making a CDA?	
Pilots (n=21)	**Controllers** (n=10)
"Given direct routeings - reducing track miles" [8] Incorrect distance to go from ATC Lack of understanding between pilot and controller of track distance to go Other traffic / sequencing / restrictions (x5) "Insufficient descent from ATC" Weather / early descent due to wind (x2) Busy ATC "since runway operations" [?] [29]	Workload / maintaining separation (x5) Remembering to do it Airspace restrictions [16] Terrain considerations [12] "Other traffic in vicinity (with several a/c on frequency – primary concern is separation and sequencing" [13]
"Because the pilot is not competent / insufficiently trained or just can't be bothered to do one" [38] Pilot error Poor planning Not starting early enough Lack of practice "The company employing several very new First Officers with little flying experience" [9] Speed management 'Speed at start point of CDA' [23] "Misjudgement of time available to cover required distance, combined with anxiety not to get high & fast: leading to a/c lower &/or slower than profile & level segment" [36]	"This is really a question for pilots" [15] Pilot not wanting to carry out a CDA Pilot not fully briefed "Other aircraft / pilot related issues" [11] Pilot requesting early descent Pilot descending too early 'Some pilots will just descend straight to 4000ft when given clearance' "Pilot consciously adjusting rate to level prior to glide slope capture" [4]

2.2.2 Attitudes to CDAs – advantages and disadvantages

In the free response questions B02 and B03, eliciting the advantages and disadvantages of CDAs, just over half the pilots citing benefits quoted fuel savings first, then noise and other environmental benefits, with the remainder quoting the noise and other environmental benefits *before* mentioning the fuel economy. As might be expected, controllers were slightly more prone to cite the noise and other environmental[*] benefits first, with the fuel saving for AOs second. This issue of the value of noise reduction is explored further, and more fully, in Section 2.2.6 – 'CDAs and society'.

Question B04 asked a similar question to B02 and B03, but in a subtly different way – this time asking who benefits, and who disbenefits from CDAs (rather than asking for more generalised 'advantages' and 'disadvantages').

Personalising the question in this way resulted in a slight shift in responses (relative to B02 and B03). Pilots *first* declared that the public benefited just about as frequently with primary references to the AO fuel saving, and controllers shifted to being more likely to cite AOs as beneficiaries (due to the fuel saving).

Interestingly, the AO managers were more likely to anticipate benefits to the *airport*, in terms of reduced noise complaints, as these respondents (presumably) had rather greater contact with the airport authority. This relates back to the point made in Section 1.1 about the potential difference between 'organisational' (strategic) and 'personal' (tactical) perceptions. Whilst this is an interesting point, and serves at least to illustrate the difference between the strategic and tactical interactions, it is to be noted that several pilots also first referred to CDA benefits in response to Question B04 as conferring on the airport, even if occasionally slightly more cynical, e.g. offering a "lower noise signature for future planning application" [25].

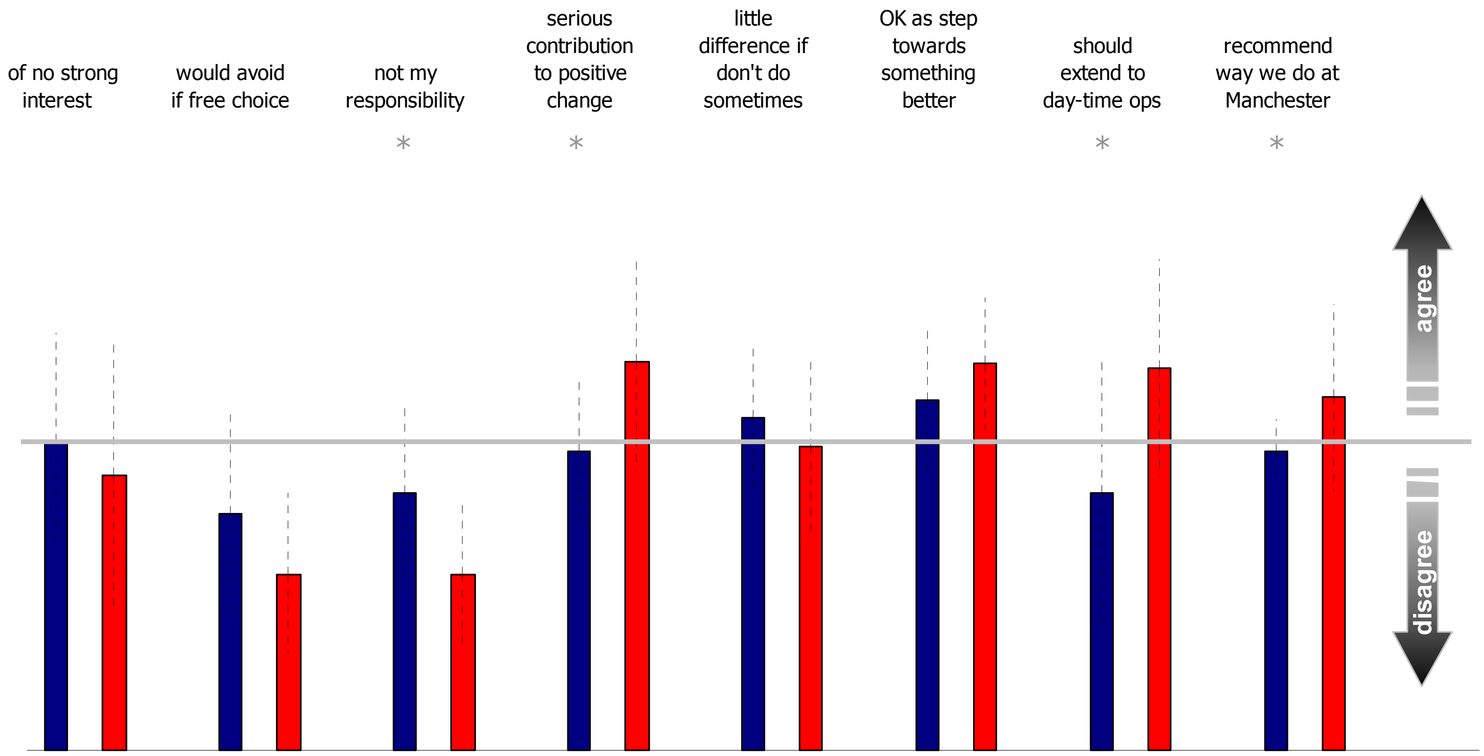
Whilst citing airport benefits was not a feature of controller responses to Question B04, Table A08.1 does not support any disparity of view here between controllers and pilots – both apparently equally likely to cite benefit to the airport when prompted in Question A08. This illustrates potential disparities between prompted and unprompted questions. In a similar vein, many pilots cited passenger comfort as a benefit of CDAs (in free response to Question B04) such that had this been included in Question A08, a high rating might have been expected for it.

[*] Note that several respondents referred to "noise" and "environmental" benefits. Whereas "noise" is often treated in the literature as an environmental issue, this Report has followed the terminology used by respondents, when referring to their responses. Changing respondents' use of "environment" to, say "air quality", to differentiate it from issues associated with noise may well instil the terminology with particular meaning unintended by the respondent in certain circumstances.

Table A04 - Attitudes to CDAs

Please indicate your levels of agreement, or disagreement, with the following:

Achieving continuous descent approaches during night-time operations at Manchester…

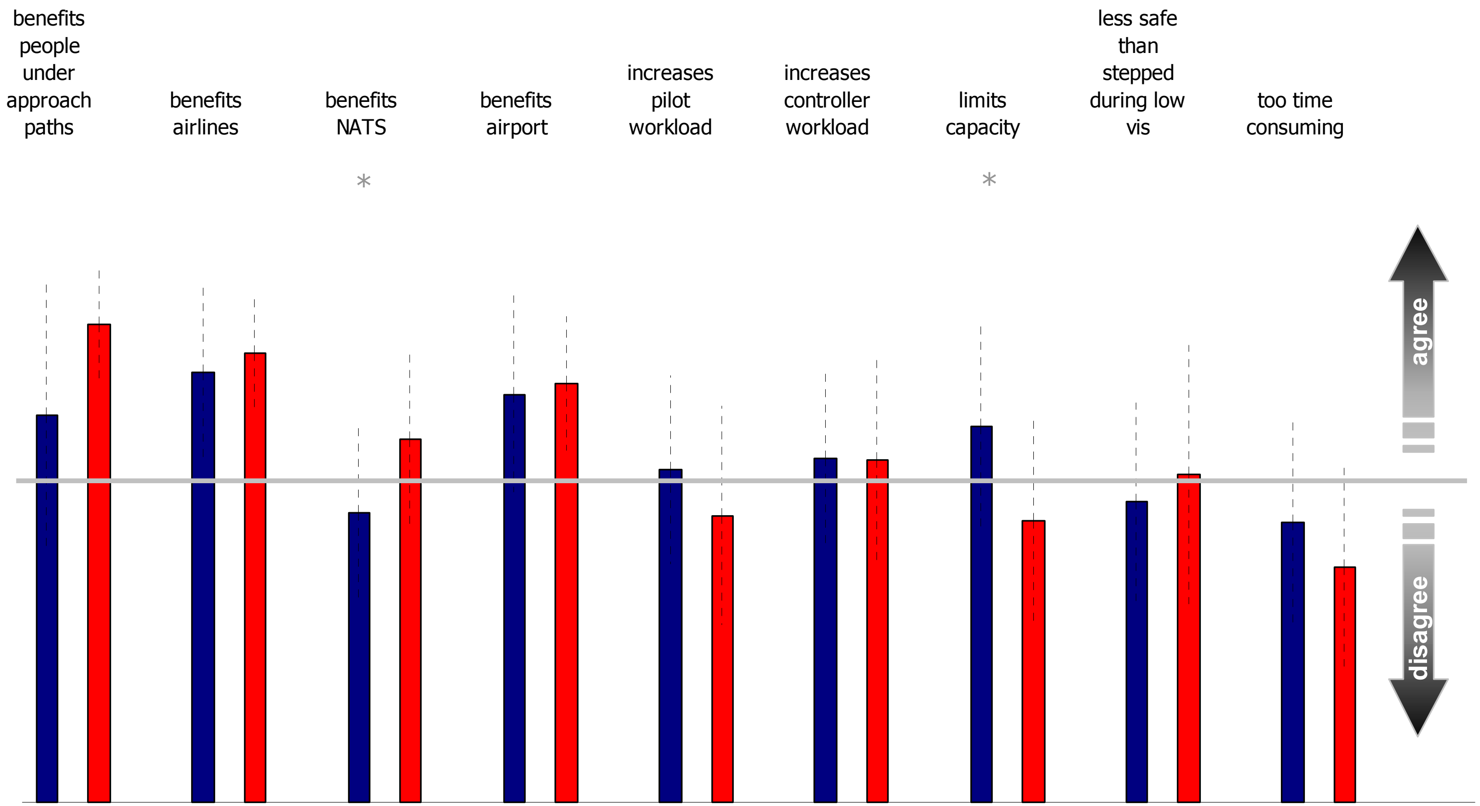


(red)	Pilots (n=21)
(blue)	Controllers (n=10)

Table A08.1 - Benefits of CDAs (1)

Please indicate your levels of agreement, or disagreement, with the following:

Achieving continuous descent approaches during night-time operations at Manchester…



Red	Pilots (n=21)
Blue	Controllers (n=10)

For responses to questions A04 and A08, each response in the questionnaire has been allocated an interval scale from 1 (disagree strongly) to 5 (agree strongly). This has enabled the results to be plotted in tables A04 and A08.1 (full item texts in Technical Annex 1). Whilst it is unwise to invest too much meaning in the absolute, mean values obtained (e.g. 4.2 compared to 4.1), it is informative to compare the relative heights of the bars in these tables.

The horizontal grey line across the plots represents a value of 3 (“neither agree nor disagree”) and the pecked vertical bars (¦) represent the standard deviations (‘variability’) in the responses obtained. It is important to note that the sample sizes obtained do not strictly allow a statistical analysis of the results, and that the standard deviations and relative heights of the bars should be treated as a qualitative aid only, to the interpretation of the results.

Although the remit of this Study was only to offer qualitative analyses of the results, this method of presentation also shows what type of analysis could more formally be possible with slightly larger sample sizes.

Broadly speaking, blue and red bars which are fairly near to the horizontal grey line are more likely to represent neutral opinions from respondents. This is loosely the case even when the blue or red bars are above or below the grey line, if the pecked (¦) standard deviations’ bars still overlap the grey bar. Bars above the grey line represent more agreement with the statements, those below indicating relative disagreement.

The immediate impression from Table A04 is that many responses are thus quite neutral. The most notable exceptions to this are the responses to “Something I’d avoid if I had a free choice” and “Not my responsibility”, both scoring relatively high in the direction of the disagreement, indicating a positive response from both pilots and controllers alike, in terms of accepting responsibility and adopting an engaged rôle in the trial.

Another pattern is that the controller and pilot responses follow very similar patterns. For example, the only conspicuous example of a red bar being above the grey line, and a blue bar below it, is the case of the response to “Should be extended to day-time operations”.

The pairs of bars marked with an asterisk (*) indicate a greater possibility of real differences of opinions between the controllers and pilots. Carrying out independent t-tests (under assumptions of either equal or unequal variances), differences marked (*) all suggest statistically significant differences ($p<0.01$ – kindly be reminded that these are only indicative, as these tests cannot be defended statistically due to the low sample sizes). One pattern does seem apparent, however – in each case where there is some suggestion of a difference between pilots and controllers, it seems to be the pilots who are the more positive in their attitude to the trial.

Looking to Table A08.1 for some possible explanation for this potential discrepancy, it is noticeable that the two primary candidates for differences of opinion here are the items “benefits NATS” and “limits capacity”, whereby pilots may be more prone to discern a benefit to NATS, and less likely to discern a capacity limitation. These findings are illustrated by a breakdown of these responses in Table A08.2.

Table A08.2 - Benefits of CDAs (2)

Please indicate your levels of agreement, or disagreement, with the following: **Achieving continuous descent approaches during night-time operations at Manchester…**		
	Pilots (n=21)	**Controllers** (n=10)
"… benefits NATS"		
agree	**6**	**2**
agree strongly	**2**	**0**
"… limits capacity"		
disagree	**6**	**2**
disagree strongly	**3**	**0**

Of all the mean scores across tables A04 and A08.1, the highest are to be found for the bars on the left of Table A08.1, whereby three of the mean scores are at, or above, a mean score of 4 (not equalled anywhere else in the tables). These findings are reflected in Table A08.3:

Table A08.3 - Benefits of CDAs (3)

Please indicate your levels of agreement, or disagreement, with the following: **Achieving continuous descent approaches during night-time operations at Manchester…**		
	Pilots (n=21)	**Controllers** (n=10)
"… benefits people living under approach paths"		
agree	**11**	**3**
agree strongly	**9**	**3**
"… benefits the airlines"		
agree	**15**	**4**
agree strongly	**5**	**3**

These represent very high levels of agreement (the reader is respectfully reminded of the lower number of controllers), and the only "disagree" responses across all respondents for these two items were three controllers, disagreeing with "… benefits people living under approach paths". This somewhat echoes the possibility of slightly stronger pilot support discussed above. It is also to be noted that agreement levels with "… benefits airport" are also pretty high, for both pilots and controllers.

~*~

It is to be noted that, overall, disadvantages and disbenefits cited (in Question B03 and B04, respectively) were rather rarer than advantages and benefits quoted by respondents.

A few respondents (pilots and controllers) saw the CDA trial as a progression towards something better (weakly supported by Table A04), examples being better standardisation of procedures in the future (controller comment) and the adoption of P-RNAV procedures (AO manager[7] commenting on the airlines' desire to keep in pace with all new developments, as it is otherwise easy for an AO to find itself 'left behind' in a rapidly changing ATM environment). This 'progressive' sentiment was echoed by the Environment Department of Manchester Airport.

Whilst this Section has demonstrated a considerable degree of conformity between responses, there was sometimes disagreement between controllers and pilots, e.g. one controller[6] stating that a disadvantage of CDAs for pilots was slower approaches due to speed reductions, echoed by one pilot[21], but contradicted by two other pilots (citing faster approaches).

Finally, in this Section, assessing how attitudes towards CDAs changed as a function of experience, Table A09 shows that the commonest response to Question A09 was to indicate 'no change'. Looking at the free-response texts written in answer to Question A09, for half of the controllers a neutral 'no change' response was indicated, with two having the same level of support as before the trial:

> *No real change as I used to do it at Heathrow* [4]

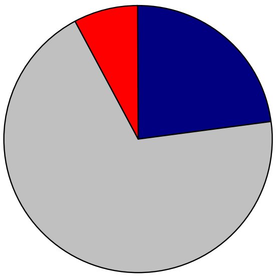
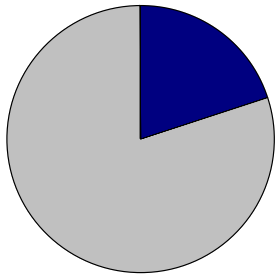
> *No change. I have always endeavoured to give aircraft continuous descent wherever possible. I am not carrying out more or less CDAs since the trial began and think this is true of most of my colleagues.* [12]

This attitude is reflected also in the pilot responses, with six indicating the same (continuing) support. As was seen in a response to Question A06 (above), airlines may already have been encouraging the use of CDAs in any case:

> *The company policy is to try to achieve CDAs where possible – even if the specific airport does not carry out CDAs* [30]

The above sentiment was expressed very clearly by all three AO managers interviewed more in-depth, and relatively frequently by line pilots at various points throughout their questionnaires.

Table A09 - Change in attitude towards CDAs

Has your attitude towards CDAs changed at all as you have gained more experience? Would you say you have become more or less supportive, or no change, since the earlier days of the trial? Why?	
Pilots (n=13) 	**Controllers** (n=10) 

	less support (= 1 pilot only)
	(even) more support
	no change (see text)

Whilst three pilots indicated a *'neutral'* 'no change' in response to Question A09, the same number of pilots indicated even more support. Two controllers also indicated (even) more support:

> *Slightly more supportive of CDAs. Realisation that noise is reduced for surrounding area. Obviously this is a minor issue. The real reason is financial.* [2]

> *More supportive as CDA less disruptive to my working practices than anticipated.* [5]

One controller indicated 'no change', but still having reservations about CDAs, and only one respondent in the whole sample (a pilot) indicated less support as the trial progressed:

> *Slightly less supportive due to the "above"* [*] *profile used by ATC & associated* [work?] *increase in final stages of approach* [9]

Even this isolated example of less support is only expressed as being 'slight'. The overall impression furnished from the replies to this question, is that most responses were either neutral or expressing continued/increased support.

[*] see controller comment about 'dive under' in lower half of Table A10 for similar comment, and see also discussion of rushed approaches in Section 2.2.4

2.2.3 Attitudes to CDAs – workload issues

The bars in Table A08.1 regarding views on whether CDAs increase pilot and controller workloads are quite close to the grey line. This at least supports the view that there is no marked belief with pilots or controllers that CDAs either increase or decrease their own workload, or that of their counterparts. However, at the same time, it should be pointed out that these bars being near the 'neutral' grey line hides the fact that there was quite a range of agreement and disagreement on these items, with the net effect being neutral.

Do many pilots and controllers feel that CDAs make workloads easier for their counterparts, but more difficult for themselves? It seems not. No pilots thought that CDAs increased their workload, but reduced the workload of controllers, and only a couple of controllers were of the opinion that CDAs increased their workload, but reduced that of pilots.

Relatively few pilots or controllers mentioned increased workloads (unprompted in Question B03 and B04) for either themselves, their counterparts, or both. Indeed, several pilots declared that there was a workload *reduction*, for example as a consequence of making descent planning overall more easy[33]. Many declared that workloads were practically unchanged, particularly pilots, as many of these were already used to carrying out CDAs where possible.

Workload was, however, cited by around half of controllers in Table A05 as a reason for not achieving a CDA (although, of course, not implying that is a reason half of the time that CDA opportunities are missed).

Several controllers did declare that carrying out a number of simultaneous CDAs made maintaining separation more difficult, especially during higher traffic, or in weather. Many found it difficult to judge exactly how many simultaneous CDAs they could actually manage, especially if the trial were to be extended to busy daytime operations (several being therefore against this), but others indicated that more than about five might be difficult. Mostly it seemed to be a 'gut reaction' when there were too many aircraft to monitor at once 'further out'. Some had managed higher numbers at Heathrow, and were not apprehensive about any extension to daytime operations at Manchester.

2.2.4 Attitudes to CDAs – increased operational complexity

Considering responses to questions A08, B03, B04 and B05, the following were cited as potential causes of increased operational complexity when attempting CDAs, as compared with stepped approaches:

- performing CDAs during low visibility
- increased possibilities of rushed approaches
- less stable approaches
- greater difficultly capturing ILS

The purpose of referring to these perceptions here is to illustrate a potential barrier to the accomplishment of CDAs, if some pilots believe them not to be as desirable as stepped approaches in all conditions, or, for example, more likely to lead to rushed approaches. It is to be noted that rushed approaches, although undesirable, are a managed facet of ATC, with contingencies built into operations to deal with them in a safe manner should they result in a go-around.

Performing CDAs during ‘low visibility’ was mentioned in Question A08, and thus more likely to be cited more often as a result of prompt bias (as was understood at the time of questionnaire design, although a response to this issue was desired in Question A08).

These increased complexities may be variously linked, but are not necessarily mutually causal. For example, a less stable approach (e.g. during turbulence) could lead to greater difficulty capturing the ILS, or to an increased possibility of a rushed approach, but may well lead to neither. It is not implied that these issues compromise safety.

Looking more specifically at examples in the questionnaires, responses to Question A08 illustrated that some respondents felt that CDAs were less safe than stepped approaches during ‘low visibility’, although it is to be stressed that the overall distributions were fairly evenly distributed around the neutral mid-point (“neither agree nor disagree”). In response to Question B05, pilots offered:

> *I always aim for a CDA. The only exception would be prior to a LVP approach or non-precision approach in limiting conditions when I would allow approx 2 miles before descending in the procedure. This gives a little extra time to “settle” the aircraft. During non-normal procedures, where workload is high, then a CDA would be of lesser concern BUT it must be remembered that a CDA profile should be standard operating procedure within a crew exhibiting good situation awareness.* [24]

> *CAT III app*[roach] *may be easier without CDA* [39]

> *I would rather always perform a CDA except perhaps when required to fly a non-precision approach to minima, when I feel the final descent should be from level flight in an appropriate and stable configuration* [10]

Notwithstanding such considerations, another pilot[26] explicitly stated that CDAs could be *advantageous* in ‘turbulent’ weather, as they avoided levelling off in ‘turbulent layers’, whilst a further comment[33] declared that a CDA:

> *Reduces level bust risk simply by having less intermediate level-offs*

Concerning rushed approaches, one AO manager[7] referred to the increased possibility of these occurring during attempted CDAs, and several line pilots mentioned the greater likelihood of arriving with too much energy[19,25] (height/speed), of staying too high for too long due to incorrect track estimates or due to pilot estimation error[38], and of speed reduction being more difficult, with a greater chance of ending up ‘high and fast’ – and therefore with an increased likelihood of a go-around[36], as echoed in:

> *Possibility of rushed approaches in not having intermediate levels-offs to slow down* [33]

As explicitly pointed out by both a controller[12] and a pilot[25], pilots may prefer to be level at 2000ft to intercept the ILS, rather than to capture it from above, during a CDA. Some pilots thus felt that CDAs offered a less certain method of ILS capture. Concurring comments in responses to Question B03 and B04 referred to ATC holding the aircraft above the ‘ideal profile’ for ILS capture, which may result in “having to use speedbrakes – or even worse – the landing gear in the latter stages of the approach to join the glideslope of the ILS”[9].

Other pilots declared various disadvantages of CDAs to be “lack of stability in approach phase of flight”[25] and the potential of having less correction time or space[34].

It is important not to make inflated issues of these concerns regarding CDA complexities, but if some pilots (disproportionately) believe that CDA attempts may lead to rushed approaches, for example, there is an opportunity to potentially improve this situation through better awareness and/or improved training and/or more accurate/regular track estimates from ATC.

2.2.5 Possible improvements to CDA process

In terms of potential improvements to the operation of CDAs at Manchester, a point made by one AO manager was that pilots need to have confidence in advance that the CDA will be executed, and in a predictable way, and not suddenly abandoned due to ATC instruction:

> *As workload increases, the accuracy of a CDA may decrease. Only ATC intervention will cause pilot to abandon the CDA, e.g. if suddenly decide to turn the a/c on, pilot will think: "Stuff this, I can't recalculate the RoD"* [7]

As one of the pilots offered:

> *It's usually only in later stages that it becomes clear it* [a CDA] *isn't going to be achieved* [36]

This point may be broadened into a somewhat wider comment on predictability. An example airport (not in the UK) was cited by one AO manager whereby ATC very often gave sudden turn-ons or directs to the pilots, such that they subsequently very often did not even try to start a CDA in the first place, on approach to that airport. It was further explained that pilot disposition towards a CDA attempt, based on the anticipated likelihood of being able to carry one out successfully, might be determined by previous experience based on the time of day, or the earlier instructions of en-route controllers.

In other words, pilots often 'second guess' ATC behaviour, based on local knowledge. One AO manager commented that it was not uncommon for the Intermediate Director at Manchester to give a wider angle than would be expected, but *without* a range update, from which the pilot would still infer he was going to be path-stretched.

Direct centre fixes from London ACC (before the STAR at Manchester) usually require a more rapid initial descent[8], making CDAs more difficult, and two of the AO managers also referred to problems coming into MIRSI (being held level for too long, and / or being directed 'too low').

In terms of predictability, one AO manager expressed a preference for the 'gate' method[*] (whereby all aircraft intercept the glideslope at the same point) and would have liked to have this coupled with a P-RNAV approach from the STAR (instead of vectoring). Two controllers[12,16] specifically suggested P-RNAV approaches too, to help manage the CDAs, particularly in the light of the terrain (hills) problem to the south / south east of the Airport, and the fact that maintaining some CDA profiles in practice was not possible as they would require running aircraft below controlled airspace. P-RNAV approaches, it was stated, would give a much greater number of 'automated vectoring' points over which to manage the descent profile.

Another controller[6] suggested an analogous, but more manual approach to the problem: by having a set of published altitudes and track distances to act as targets to follow. Although several pilots thought the CDA process could not be improved, most pilots offered suggestions as to how it could be ameliorated. Some of the commonest requests were offered as multiple sets of suggestions, which can best be summarised as:

[*] It was reported that the Airport had preferred not to use this method, so as not to focus approach noise.

- better track estimates, coupled with better ATC understanding of the connection between speed and track distance, exemplified by:

  I felt the controllers did not understand how the necessity to slow down during the CDA affects the descent gradient [10]

- more consistency between controllers (and their instructions)

- better predictability about point of glideslope capture (e.g. 'gate' method)

- being told about the CDA possibility earlier on / further out, on first contact with Manchester. Table A03 indeed suggests some room for procedural clarification.

Returning to the first of the above bullet points, pilot opinion on the utility of ATC in assisting CDAs varied (in fact, note that the first two comments are from the *same* pilot):

> *When tired at end of long day, it is sometimes better to have someone helping you (i.e. controller). Tiredness would lend itself to incomplete CDA.* [37]

c.f: *Controllers might be able to handle aircraft in their zone more effectively if pilots take responsibility for CDA. Controllers would have (better) more time on overall picture* [37]

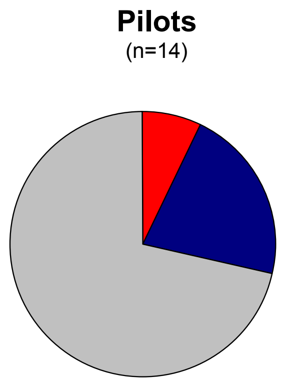
> *For ATC to instruct the aircraft crew during a CDA is like a passenger without a driving licence sitting in the back of* [a] *bus telling the driver what to do whilst using a mobile phone. A CDA requires a 3° descent profile (approx) so that is what is required by the crew* [20]

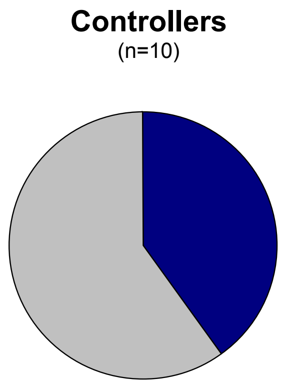
This latter sentiment was echoed by another pilot[26], stating that ATC needed to better understand the manoeuvrability of different aircraft, and a controller[14], explaining that it was often difficult to anticipate pilot's descent rates, as pilots in a given sequence do not all behave alike.

> *I always put an extra element of safety in. I would not clear from 5000ft to 2500ft if traffic ahead – because they might get straight down. You can't always trust them to stay up* [18]

Table A03 - Initiating CDAs

During approach, is a CDA usually:





(red)	specifically requested first by the pilot (= 1 respondent only)
(dark blue)	suggested first by the controller
(grey)	left as an implicit possibility (e.g. within pilot autonomy, based on descent clearances)
(purple)	other (= 0 respondents)

Another controller[15] expressed their opinion (in response to Question B05) that the trial was not set up well, and also suggested that the descents should not be initiated by the controller ('who has least real knowledge of when the descent should begin') but should be left to the aircraft crew.

Controllers generally offered fewer suggestions for improvements to the trial than the pilots, but several mentioned the problems of local terrain and airspace restrictions[*], and several others felt that an extension of the CDA trial to daytime operations would be difficult or unworkable (as discussed already in Section 2.2.3, as a workload issue). Other comments from controllers included an agreement[4] with many of the pilots that CDAs should start much further out, and, furthermore, that pilots should be better briefed[12].

All in all, whilst there is clearly a balance to be struck between dealing with operational challenges through increasing standardisation of procedure, at the expense of flexibility, it appears that there was an overall preference, amongst pilots and controllers, for greater standardisation.

Finally in this Section, recommendations to other airports (asked at Question A10, partly as a proxy question to further catch any perceived shortcomings in the Manchester trial) were somewhat varied - and more were offered by pilots, than by controllers. Considering the number of pilots who had elsewhere commented that CDAs should be more predictable and start further out, it might be surprising that similar comments were not made frequently in response to Question A10. This could well have been because this question occurred towards the end of the questionnaire for pilots (who may thus have felt that the point had been already covered).

[*] The issues of terrain and airspace restrictions, and of standardisation of procedures, was also mentioned in Section 2.2.1, where the context of the introduction of the trial was considered.

Table A10 - Recommendations to other airports

As you probably know, other airports in Europe are considering CDAs. What key recommendations would you make to other airports relating to the way CDAs are introduced, drawing on your personal experience at Manchester?	
Pilots (n=21)	**Controllers** (n=10)
"Use the Manchester trial as an ideal way to introduce the trial" "It really does make little difference to the day-to-day operation of a professional crew"	"If we introduce it for every a/c, all day, every day then we can realise the benefits. I would recommend that other airports use it for all flights, not a very small percentage" "Carry out a trial procedure before settling on the definitive"
"Accurate distances to run & indication of position to join localiser/glideslope to assist in planning profile." "Controllers need to be trained to appreciate the various factors which affect our descent gradient." "Tell the airlines to urge their flight crews to carry out CDAs & practice them at uncluttered airports where visual approaches are permitted" "[They should be] advertised!! Removal of ALT restrictions and speed restrictions. Constant track mile updates." [22] "Be aware that different aircraft have different speed and descent ideal profiles" [27] "Plan ahead better. Produce viable approaches + publish them. Be realistic." [37] "Make them 'normal', if we all did them all the time it would get easier. It would mean greater coordination between ATC agencies which would be a good thing (if within controllers' workload capacity)." [39] "Enough controllers with expertise" [41] "They should start from much higher"	"Ensure inbound/outbound routes are separate so you don't have to 'dive under' outbounds which negates the whole point" [4]

Since common controller issues with CDAs were to do with traffic volumes and terrain, which are difficult to change, this may explain their relative lack of expression in answer to this question. The question generated no comments on improving benefits to the public.

2.2.6 CDAs and society

As mentioned earlier, respondents were not told that the interviews were aimed at investigating the impact of societal influences on behaviour, in the context of change in ATM. Had this been declared, this would have very likely led to response bias, i.e. resulting in the societal influence being mentioned, or stressed, more strongly than it would otherwise have been, thus not giving a true representation of its effect. As far as is possible, therefore, the adopted approach sought to allow the societal impact to find its natural, unbiased context in the feedback.

Question B05 ("When deciding on a case-by-case basis whether to try for a CDA, how would you summarise the key factors you are trading-off, e.g. your workload *versus* what?") was asked partly to see how many pilots and controllers would mention trade-offs in consideration of noise, and local residents.

Controllers mentioned the trade-off between increased workload and maintaining separation, for example stating that it was not possible to give all aircraft a CDA, as proximity became a factor, or that they would not give a CDA to one aircraft if it hindered other flights[15,17]. Many controllers again mentioned airspace and terrain restrictions at Manchester as being a limiting factor ("you can't always descend them from 5000ft to 3000ft" [12]). Pilot cooperation and requests for early descents[14] were also raised.

In terms of trade-offs, the AO managers, in particular, again stressed that CDAs were already the expected 'norm' of descents (as mentioned in Section 2.2.1) although pilot inexperience and, in certain cases, lack of appropriate training, might be a factor acting against achieving CDAs, as indeed expressed by a line pilot:

> *Inexperienced pilots have to learn the procedure as it's not learnt during basic training* [31]

One AO manager thought an increasing reliance on computerisation might lead pilots to feel that CDAs involved too much extra work. Indeed, workload and fatigue[19] were mentioned in response to this question by a number of pilots, although many also declared that extra workload was not a factor, for example:

> [it is] *just a different workload* [26] [authors' emphasis]

Since Question B05 specifically asked for trade-offs, it might be expected that these references to workload, taken at face value in terms of frequency of responses, might over-represent the balance of views. Indeed, the reader is reminded that in Section 2.2.3, extra workload was pretty much a neutral issue taken across the whole sample.

Benefits quoted echoed those described earlier in Section 2.2.2, including reductions in fuel burn, time savings and passenger comfort. Negative factors in the trade-off equation for pilots included a need to prioritise the avoidance of bad weather / wind, and the possibility of rushed approaches and, in some instances, not favouring CDAs under LVP (see Section 2.2.4). One pilot[32] mentioned a consideration of *controller* workload as a negative aspect in the trade-off.

Safety was mentioned in this context by one pilot only, although it did not appear that the inference was in any way that CDAs were less safe. The comment seemed to imply more that prevailing conditions might sometimes not be compatible with a CDA:

> *SAFETY – i.e. high ground, tailwinds – affecting decent rates – turbulence – operational reasons relating to any particular "technical" areas – GPWS warnings – to go around high ground east of MAN* [37]

So, in response to Question B05, where does noise, and the corresponding societal considerations, appear specifically in the trade-off consideration? Only three pilots mentioned noise as a trade-off issue:

> *Less noise disturbance to those on ground* [9]
>
> *Lower noise signature + local resident public relations* [25]
>
> *Less noise on ground* [27]

The latter pilot qualified this comment by saying that the benefit of noise reduction was *secondary* to those of smoother flights for passengers and to fuel savings, since the aircraft was very quiet anyway - a comment which was echoed in responses to Question B07, and by another pilot (in response to Question B05) which appears to be somewhat negative toward CDAs:

> *The type of aircraft I fly (Dash 8 turboprop) is not noisy during the initial and intermediate parts of the approach. Given this, I would be somewhat reluctant to trade off the CDA benefit of lower noise profile – with any increase in workload during a busy phase of flight.* [28]

However, in Section 2.2.2 ('Attitudes to CDAs – advantages and disadvantages') a clear benefit towards the public was perceived from both pilots and controllers (as evidenced in Table A08.1 and Table A08.3, for example).

Responses to Question A07 suggested that concerns about noise complaints *per se* were less marked. Fourteen pilots declared that they were 'seriously concerned' or 'somewhat concerned' about 'the potential of noise complaints being generated by the public in the event of night-time CDAs generally not being used', and two controllers expressed the same levels of concern.

Table A11 illustrates that quantifiable benefits had not yet filtered back to the pilot and controller communities, as might be expected, considering the stage of the trial during the interviews. This serves to reiterate the point that the timing of the interviews for the various project case studies is an important context in which to set results, as has been mentioned in Section 1.1. No reductions in noise complaints were mentioned in response to Question A11, nor had the Environment Department at Manchester Airport expected any drop in such numbers at this stage – complaints further than approximately 8 miles out were quite rare. With Manchester Airport not having a night curfew, residents were less sensitive to night movements (i.e. during the time the trial was in operation) than, say, they might be at Heathrow. Furthermore, December to January (i.e. just after the trial's introduction) is a period of relatively low night-time traffic at Manchester.

(It is worth noting in passing, that since many AOs encourage CDAs wherever possible, including at Manchester before the trial started, this led one AO manager to raise the issue of needing to be careful when using 'before' or 'non-CDA' baseline FDR data for calculating fuel savings).

Table A11 - Awareness of quantifiable benefits [see comment in main text]

Are you aware of any quantifiable benefits which have resulted from CDAs at Manchester – e.g. fuel savings, reduced complaints about noise from the public?	
Pilots (n=21)	**Controllers** (n=10)
No (x14) "Fuel savings" (x4) "Not yet" "A more 'professional' approach" "Passenger comfort" "Engine wear reduced" "None – would like to know though" [38]	No (x8) "Not quantifiable at this stage" "Yes" [but no details given]

Responses to questions B07 and B08 gave a specific insight into the attitudes of the respondents regarding the core focus of the Study definition, as defined by EEC, which was quoted in Section 1.1, i.e. to assess:

how directly and how intensely ATC personnel feel community pressure and through what processes

Indeed, responses to these questions indicated a distinct lack of immediate community impact on either the pilots' or controllers' day-to-day behaviour. Selected responses to Question B07, include:

Please could you outline the extent to which you feel <u>personally</u> that the public response to aircraft noise affects your day-to-day decision making when it comes to trying to achieve continuous descent approaches?

From pilots:

> *It crosses my mind – what drives my behaviour is efficiently flying the aircraft, which, in turn, means less noise* [1]
>
> *On a <u>departure</u>, I am much more concerned about noise footprints* [20]
>
> *Continuous descent is … more for reasons of passenger comfort and fuel saving* [23]
>
> *We fly a company and legal profile … changes must be made at organisational level* [26]
>
> *Because I live on the approach to Manchester Airport, I believe I probably think more about the effect of aircraft noise. However, my company has very specific Standard Operating Procedures which limits how much scope we, as pilots, have in reducing aircraft noise on approach* [30]

> *I know when I'm on the ground I don't like it and by keeping the public happy I help to safeguard my job. Besides, from a professional point of view, it is more rewarding to fly an efficient CDA than not to do so* [38]

From controllers:

> *Noise is at the back of my mind – but not a priority* [2]
>
> *Separation is everything* [4]

Selected responses to Question B08, include:

In what ways do you consider your job, as regards <u>approaches at Manchester</u>, is more difficult compared to approaches at some other European airports, where there are no / very few people living under the approach path of inbound aircraft?

From pilots:

> *It is more complex at Manchester because of all the speed, descent and crossing constraints required at a busy airport set within a large conurbation* [20]
>
> *Very little … fuel saving … just happens to coincide with a minimum in noise level* [9]

From controllers:

> *It's more of an airport thing – they decide what's OK. We accept what we get, and deal with it as it comes in.* [5]
>
> *Only affects departures … approaches have to come in straight. Only make a lot of noise when climbing. CDAs are there to save fuel. Further out they don't notice – flaps are noisiest on approach. Only on final approach do a/c follow exactly the same tracks.* [12]

One pilot[39] commented that "our children + their children will benefit most if we reduce fuel consumption" and in response to Question B02, another pilot[40] made a rare comment regarding the benefits of CDAs with respect to "local relations with neighbouring towns / villages".

Only one respondent[28] across the pilots and controllers mentioned safety in response to questions B07 and B08, declaring that too high a focus was placed on noise concerns, as echoed by one controller[15] in response to Question B05.

Similarly, in response to Question B08, respondents might have said that considerations of the noise impact on people living underneath approaches made such approaches over built-up areas more difficult, but this issue was apparently of very little concern to respondents, in the context of this response.

Towards drawing qualitative conclusions from this Section, it is clear that concerns regarding societal impact and noise are distinctly low in the list of priorities for pilots and controllers alike. Whilst safety is of paramount importance across the whole respondent base, the economies of fuel saving (in particular) and the 'professionalism' (e.g. increased passenger comfort) of CDAs were also important to pilots.

It can be said that generally, to the extent that CDAs were compatible with existing priorities of pilots (safety, economy) and controllers (primarily separation and expedition), they were accepted by both sets of respondents. This was tempered somewhat by actual annoyance by some respondents that noise issues near airports received such a high profile.

There was also some evidence for a somewhat persistent ‘departures culture’ regarding noise (see also Section 2.2.1 - ‘Introduction of CDAs – context and consultation’), with arrivals noise less of an issue, and with some pilots stating that their aircraft were in any case very quiet (especially in response to Question B07).

In answer to the latter part of the question posed at the start of this Section (“how directly and how intensely ATC personnel feel community pressure and through what processes”), it can be suggested that there is some deferment of this responsibility from pilots and controllers to the ‘system’, as established at the strategic level, illustrated by two responses to Question B08:

> *No difference – I fly the approach plate* [8] [pilot]

> *The airport is the interface, ATCOs are not bothered about noise* [6] [controller]

Of course, this sentiment cannot be substantiated quantitatively, but it is indeed supported by views expressed by the respondents, and it is difficult to find contradictory acceptance of *personal* responsibility for noise *per se*.

In initial reporting for this Study, Figure 3 was devised to represent the various interactions between stakeholders in the complex interactions involved in ATM change, and in trying to understand the place of societal influence in that structure. Based on the above commentary, it is possible to hypothesise a revised structure, shown as Figure 4, with the airport authority and local government holding a more ‘central’ position in terms of assuming a position of societal interface between ‘the public’ and the ATM community.

A view suggesting the airport as the guardian and representative of the public interest, from the controller and pilot perspective, was in keeping with the experience of the Environment Department at Manchester Airport, which also stated that not only might controllers and pilots take this view, but that the public also were more likely to see the airport as responsible for such issues as noise and pollution, rather than complaining to NATS or to the airlines. This potentially infers a somewhat peculiar rôle on the airport – as a target for complaints from the public, yet also as a protector of the public interest in the eyes of the ATM community. It is to be noted that the airport at Manchester is also wholly owned by the ten local authorities (local government bodies) of Greater Manchester, representing a direct societal link, as elected representatives of the public.

Figure 3 - Earlier illustration of interactions between stakeholders

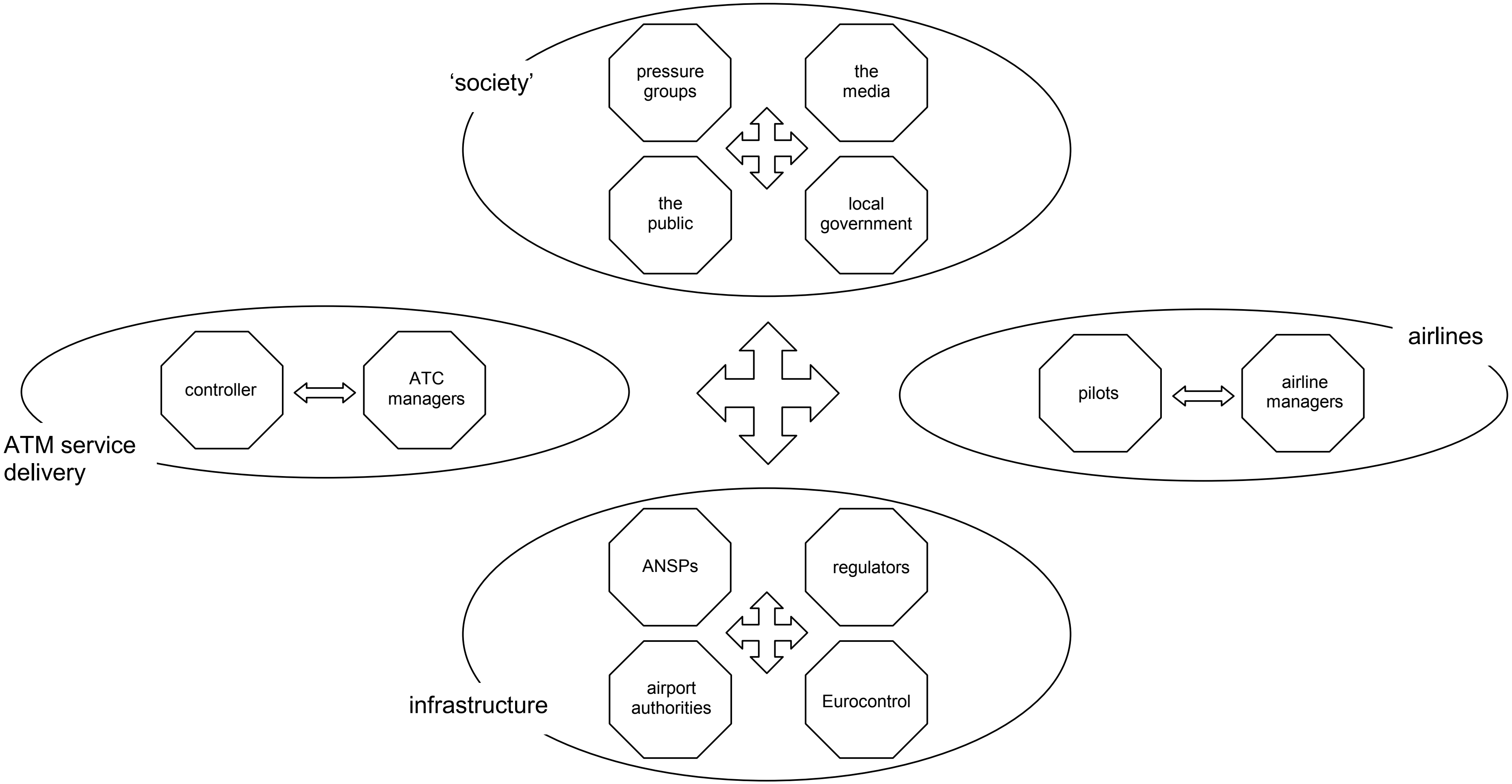
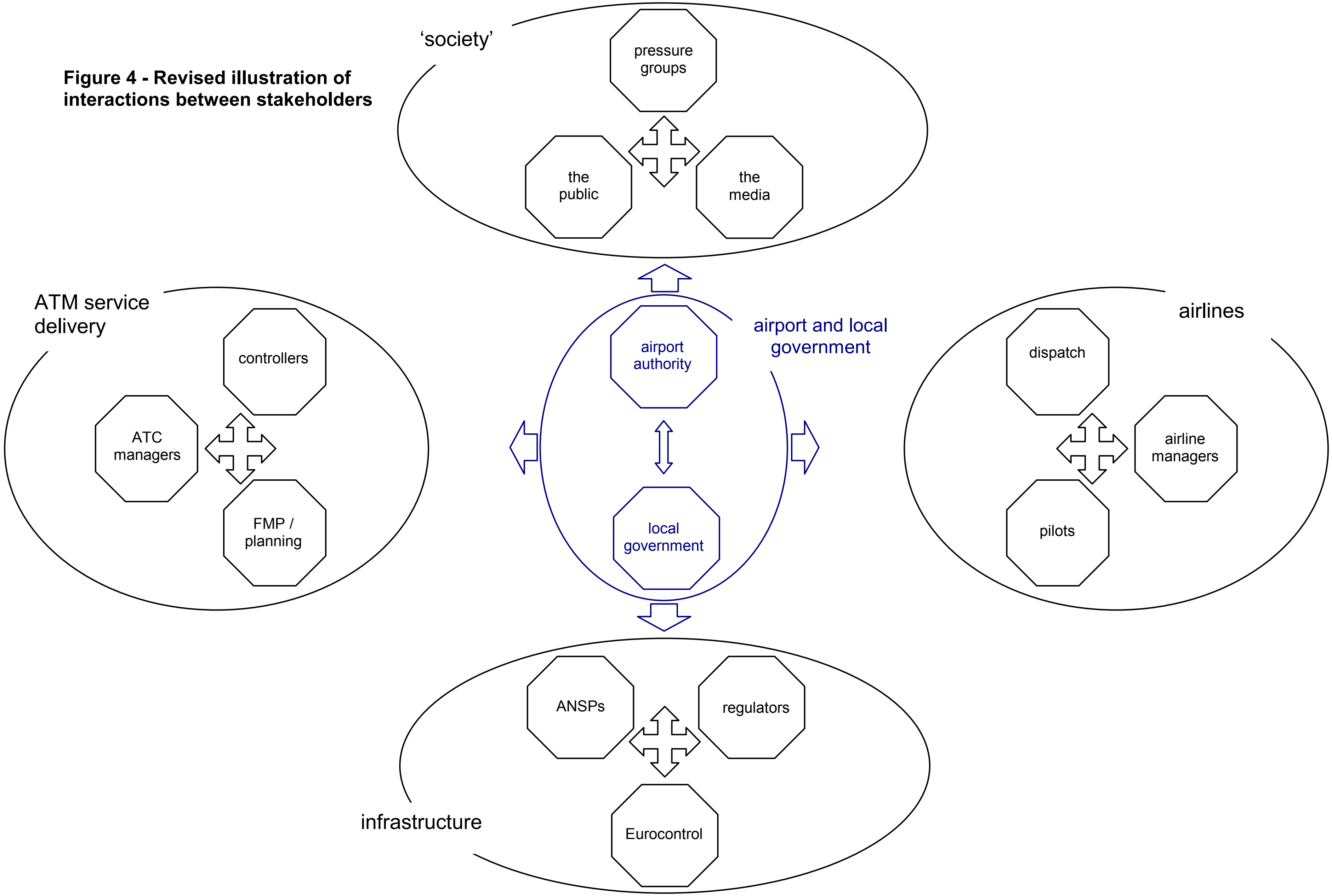


Figure 4 - Revised illustration of interactions between stakeholders



2.2.7 Internal feedback and dissemination of the Study's findings

Whilst comments on the quality of the internal feedback processes were somewhat split between the negative and positive from the controller perspective, the clearly predominant response from pilots was lack of awareness of such feedback processes, or declaring that they did not exist – with a rather more negative overtone overall, echoing somewhat a pilot comment in response to Question A02:

> *No personal consultation with myself or other line pilots … this has led to no input from those using the system most & no opportunity for ideas / suggestions in its completion* [9]

Whilst it is to be remembered that, as already pointed out, responses to Question A02 suggested that the *consultation* process was generally felt to be adequate as it stood, or not needed, an opportunity exists in the next phase(s) of this project to ask more explicitly if better *feedback* opportunities are desirable, in order to better quantify the issue of internal feedback.

In fact, the system for feedback at Manchester was that NATS supplied the Airport with a list of flights which should have achieved a CDA, and the corresponding tracks were then returned to NATS with an indication if the trajectory was CDA-compliant, or not. Controllers were then able to offer feedback (to NATS management) on non-compliant CDAs, on a flight-by-flight basis. Whilst the Airport also made these tracks available to the airlines, there was not a flow of information between NATS and the airlines, and both the Environment Department at Manchester Airport and NATS management agreed that a more focused, tripartite (or multipartite, e.g. including Eurocontrol) feedback / communication mechanism would be beneficial, although there were some reservations about how much work this would involve and about the practicalities of organising such interactions whilst the flight-by-flight instances were still fresh in both pilots' and controllers' memories.

There is insufficient evidence to support this need, at this stage, from the pilot or controller perspective, although several controllers declared (in response to free-response Question B03) that a *disadvantage* of the CDA trial was the actual feedback forms.

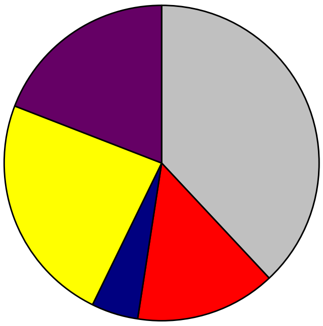
~*~

In terms of offering the stakeholders at Manchester a formal feedback session on the results of this Study, Table A13 shows that there was a distinct lack of consensus on the type of feedback required, and that, ultimately, the Eurocontrol plus University of Westminster dissemination process should cover the Study as a whole, in addition to at least some focus on the CDA trials.

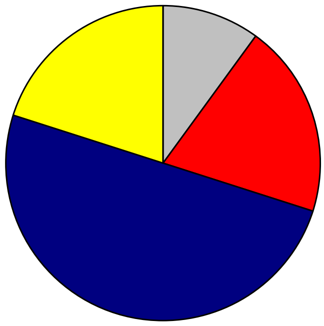
Table A13 - Feedback preferences: hearing about the Study

This Study will be looking at other CDA trials in Europe, and rather broader types of change in ATM. We would like to return to Manchester to offer a brief presentation of some of the key findings resulting from the Study. Which of the following best describes your reaction to such a feedback session:

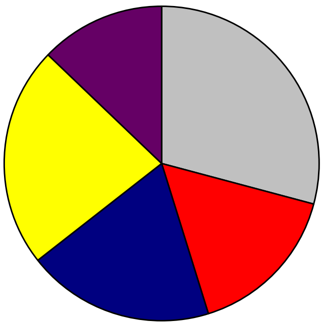
Pilots
(n=21)



Controllers
(n=10)



Overall



	(grey)		I would probably not have time to attend
	(red)		I would prefer a focus on CDA trials at Manchester
	(blue)		I would prefer a focus on CDA trials at Manchester and elsewhere in Europe
	(yellow)		I would prefer a broader presentation on ATM change in general
	(purple)		No particular views / preference

3. SUMMARY AND CONCLUSIONS

- Many respondents offered detailed and exhaustive feedback, sometimes even with supporting diagrams - strongly underwriting their commitment to this exercise and the quality of the response

- Respondents were not informed of the objective of the Study, so as not to bias their responses, instead, as far as possible, thus allowing the societal impact on ATM change to be expressed in its natural, unbiased context

- Interviews took place at a stage where quantifiable benefits of the CDA trial had generally not been assessed and fed back to the controllers or pilots

- Since most of the ‘strategic’ interviewees (managers) also played ‘tactical’ rôles (working ‘normal operational’ shifts), it has generally not been possible with this case study to draw clear distinctions of perception and attitude between these types of respondent (if such differences exist)

- Pilot and controller concerns about noise levels in particular, and about societal impacts of ATM, were overall very low

- Notwithstanding the previous point, it is worth noting that in addition to its existing undertaking towards the mitigation of environmental impacts, NATS is committed to further work in raising environmental understanding throughout the organisation, and has an Environmental Manager who will continue to work closely with airports and en-route centres alike, to further develop such awareness

- For AOs, CDAs begin at Top of Descent, and should be initiated and managed from this point, and in a predictable way. CDAs were not a new concept to many respondents – indeed, the trial was focusing only on a *part* of what many pilots attempted / did already, from ToD

- a key **driver of change** for many (but not all) respondents was **procedural standardisation**, even at the expense of flexibility

- key **barriers to change, for controllers,** were:
    - local airspace / terrain restrictions
    - workload (especially if extended to daytime operations; otherwise not a major issue)

- potential **barriers to change, for pilots** were:
    - inadequate track updates from ATC
    - concern about possible rushed / missed approaches

- Whilst safety was of paramount importance across the whole respondent base, the economies of fuel saving (in particular) and the 'professionalism' (e.g. increased passenger comfort) of CDAs were also important to pilots. It can be said that generally, **to the extent that CDAs were compatible with existing priorities** of pilots and controllers, they were accepted by both sets of respondents. This was tempered somewhat by actual annoyance by some respondents that noise issues near airports received such a high profile

- There was some evidence for a somewhat persistent 'departures culture'

- It can be suggested that there is some **deferment of social responsibility** from pilots and controllers to the 'system', as established at the strategic level, in which the Airport may play a special rôle

- only one respondent in the whole sample indicated any reduced support as the trial progressed; some pilots and controllers saw the CDA trial as a **progression towards something better**

- Overall, disadvantages and disbenefits cited as free responses were rather rarer than the advantages and benefits quoted by respondents

- The survey analysis has revealed subtle ways in which particular question phraseologies can influence the type of responses obtained, and of the difference between prompted and unprompted attitudinal measures

- It is important to consider some of the qualitative comments made in the light of corresponding (semi-)quantitative findings. Whilst quotations (intentionally) serve to illustrate the breadth of opinion, there is a natural human tendency to complain rather than praise, such that summary data, based on scalar questions (e.g. Tables A04 and A08) can be more representative of the 'norm'

4. WORK IN PROGRESS AND FURTHER INFORMATION

Whilst the Manchester results indicated that pilot and controller concerns about noise levels in particular, and about societal impacts of ATM, were overall very low, it has also been noted that in addition to its existing undertaking towards the mitigation of environmental impacts, NATS is committed to further work in raising environmental understanding throughout the organisation. It has been suggested in this Report that there may be some deferment of social responsibility from pilots and controllers to the ‘system’, as established at the strategic level, in which the Airport may play a special rôle. It is hoped that an update to this Report may be provided in subsequent reporting, to look at progress at Manchester, and any initiatives following the CDA trial - in particular any further implementation of CDAs and how this is managed at the organisational and individual levels. This will be of particular interest in the context of the Manchester survey finding, that only one respondent in the whole sample indicated reduced support for CDAs as the trial had progressed.

Several (simplifying) changes are also proposed to the questionnaire, to better suit the context of the next planned case studies: looking at CDA trials at Arlanda (Stockholm) and Henri Coanda International (Bucharest) airports. Together with Manchester, these next case studies will not only form an interesting collection in terms of the varying societal contexts, but also operationally, as the Manchester method is radar-only, Bucharest is STAR-only, and Stockholm is to be a mixture of RNAV STAR (during lower traffic volumes) or vectoring (when traffic volumes are higher).

Any enquiries regarding this Report, and other case study progress, will be welcomed by the Study team. Please ask for Dr Andrew Cook or Graham Tanner at the University of Westminster:

telephone: +44 (0)20 7911 5801 (direct)
e-mail: airspace-research@westminster.ac.uk

Technical Annexes

Technical Annex 1: Questionnaire for Manchester CDA Trials

The questionnaire used at Manchester is shown on the following pages.

Please note that page numbers referred to in the text of the questionnaire were correct in the actual version used, but have been overwritten on incorporation into this Annex, otherwise duplicate numbers will appear (e.g. two page "1"s – one at the start of this Report, and another at the start of the questionnaire).

The term "CDA" (instead of B-CDA) was used throughout the Manchester questionnaire to conform with the abbreviation used in the corresponding NATS TOI.

UNIVERSITY OF WESTMINSTER

Questionnaire for Manchester CDA Trials

University of Westminster

Harmonised version: for completion by pilots or controllers

Thank you for agreeing to take part in this survey. The University of Westminster is working on a study commissioned by the Eurocontrol Experimental Centre, which aims to understand what factors affect the way ATM change is brought about. The objective is not to assess CDAs at Manchester, *per se*, but to explore the *process* of change.

This questionnaire is designed to be used either as a fully self-completion form, or with Section B administered by an interviewer from the University of Westminster.

The reference number on each page is only so that we know the provenance of the questionnaire, e.g. who carried out the interview (if an interviewer was used) and to match up Section A and Section B (when separated by the interviewer).

By default, your response is confidential and anonymous

The survey is being carried out in accordance with the Code of Conduct of the Market Research Society. Where interviewee names are recorded (off the questionnaire) by University of Westminster interviewers, it is only to prevent the same respondent from being asked for an interview twice. Individuals' names will not be quoted in reporting.

Kindly note that we are necessarily working with relatively small sample sizes for this Study, so each response, and its completeness, is of particular importance to us. All answers and comments will be studied with utmost care and consideration, and used to inform the wider reporting for this international Study.

If self-completion: **Please start the questionnaire on page 7[*] !**

Please return in Freepost envelope provided, kindly by Friday 18 March

Thank you very much indeed

For interviewer use
Struck out invalid instructions: above, + pp 2[*] & 7[*] ❒
Filled in tracking code at foot of each page ❒
Freepost envelope given / attached ❒

Section A

If you are completing the whole questionnaire as a self-completion questionnaire, please complete Section B first (which begins on **page 7***), then return to this section.
If you were interviewed by a University of Westminster interviewer for Section B, please complete Section A now and return it to us in the Freepost envelope provided.

A01. Please could you outline any relevant context in which the CDA trials at Manchester were introduced, for example any other changes taking place at around the same time, such as in management structure, working hours, or other company plans, which may have made the CDA trial either more or less important in such a context?

A02. Regarding the CDA trial, do you feel there was sufficient consultation (including you) before its introduction? If not, what were the shortcomings of such consultation?

A03. During approach, is a CDA usually:

specifically requested first by the pilot ❒
suggested first by the controller ❒
left as an implicit possibility (e.g. within pilot autonomy, based on descent clearances from ATC) ❒

Other, please specify:

A04. Please indicate your levels of agreement, or disagreement, with the following:

Achieving continuous descent approaches during night-time operations at Manchester…	agree strongly	agree	neither agree nor dis-agree	dis-agree	dis-agree strongly
Of no strong interest to me one way or another	❒	❒	❒	❒	❒
Something I'd avoid if I had a free choice	❒	❒	❒	❒	❒
Not my responsibility	❒	❒	❒	❒	❒
A serious contribution to positive change	❒	❒	❒	❒	❒
Little difference if infringements now and then	❒	❒	❒	❒	❒
OK as a step towards something better	❒	❒	❒	❒	❒
Should be extended to day-time operations	❒	❒	❒	❒	❒
I would recommend the way we do it at Manchester, to a similar airport	❒	❒	❒	❒	❒

A05. Concerning the night-time approaches at Manchester which are expected to be continuous descents, in cases where these are not achieved, what would you say are the most common reasons for not making a CDA?

A06. Do you feel that the night-time CDAs are strongly endorsed by your managers, or that it is not of special consequence whether they are generally achieved or not?

A07. How would you describe your personal concern for the potential of noise complaints being generated by the public in the event of night-time CDAs generally not being used?

seriously concerned	❒
somewhat concerned	❒
not particularly concerned	❒
not at all concerned	❒

A08. Please indicate your levels of agreement, or disagreement, with the following:

Achieving continuous descent approaches during night-time operations at Manchester…	agree strongly	agree	neither agree nor dis-agree	dis-agree	dis-agree strongly
… benefits people living under approach paths	❐	❐	❐	❐	❐
… benefits the airlines	❐	❐	❐	❐	❐
… benefits NATS	❐	❐	❐	❐	❐
… benefits the airport	❐	❐	❐	❐	❐
… significantly increases pilot workload	❐	❐	❐	❐	❐
… significantly increases controller workload	❐	❐	❐	❐	❐
… limits capacity	❐	❐	❐	❐	❐
… is less safe than stepped approach during low vis	❐	❐	❐	❐	❐
… is too time consuming	❐	❐	❐	❐	❐

A09. Has your attitude towards CDAs changed at all as you have gained more experience? Would you say you have become more or less supportive, or no change, since the earlier days of the trial? Why?

A10. As you probably know, other airports in Europe are considering CDAs. What key recommendations would you make to other airports relating to the way CDAs are introduced, drawing on your personal experience at Manchester?

A11. Are you aware of any quantifiable benefits which have resulted from CDAs at Manchester – e.g. fuel savings, reduced complaints about noise from the public?

A12. How would you assess the feedback / monitoring process within your company, e.g. to inform you of progress and allow you to offer your views on the CDA implementation and ways in which it might be improved? Is such a process: in place, adequate, fair, acted upon?

Please use the box below for any other **comments or questions** you may have. Kindly remember that if you wish us to respond to any questions, we will need your contact details in the box on the next page.

Sharing the results of our Study with you

A13. This Study will be looking at other CDA trials in Europe, and rather broader types of change in ATM. We would like to return to Manchester to offer a brief presentation of some of the key findings resulting from the Study. Which of the following best describes your reaction to such a feedback session:

- I would probably not have time to attend ❒
- I would prefer a focus on CDA trials at Manchester ❒
- I would prefer a focus on CDA trials at Manchester and elsewhere in Europe ❒
- I would prefer a broader presentation on ATM change in general ❒
- No particular views / preference ❒

Please tick one option only

For questionnaire tracking purposes ONLY, we already know your airline's identity or the controller shift you were working when interviewed, but even this information will NOT be used in any way to identify your responses. However, should you wish to identify yourself such that we can contact you for any brief points of elaboration, or because you have asked a question you wish to be answered, please enter your contact details in the box below:

Your response remains completely anonymous, whether you complete this box or not

Interviewee contact details (IF wish to offer)
Please underline any preferred method of contact (e.g. e-mail address)

Please only contact me to answer the questions I have asked ❒
Please only contact me if the University of Westminster wishes to clarify an answer ❒

End of Section A

Please return the questionnaire in the Freepost envelope provided,

kindly by Friday 18 March.

On behalf of the Eurocontrol Experimental Centre
and the University of Westminster,
sincere thanks for your invaluable cooperation.

Please direct any questions or enquiries in the first instance to:

Dr Andrew Cook, at the University of Westminster:

+44 (0)20 7911 5801 (direct line)

or by e-mail, to: airspace-research@westminster.ac.uk

Section B

Either asked by interviewer, or:	Self-completion (please write in your responses)

B01. From whom did you first hear about the introduction of CDAs at Manchester, and what was your initial reaction to it? For what reasons was it introduced?

B02. What do you now see as the advantages of continuous descent approaches (if any)?

B03. … and the disadvantages (if any)?

B04. Who benefits the most from continuous descent approaches (if anybody)? Who suffers any disbenefits?

B05. When deciding on a case-by-case basis whether to try for a CDA, how would you summarise the key factors you are trading-off, e.g. your workload *versus* what?

B06. In what ways could the CDA procedures at Manchester be improved, e.g. from the perspective of your workload / your ability to achieve CDAs?

B07. Please could you outline the extent to which you feel personally that the public response to aircraft noise affects your day-to-day decision making when it comes to trying to achieve continuous descent approaches?

B08. In what ways do you consider your job, as regards approaches at Manchester, is more difficult compared to approaches at some other European airports, where there are no / very few people living under the approach path of inbound aircraft?

End of Section B **Self-completion interviews:** please now return to Section A, on **page 2***.
For interviews conducted by University of Westminster staff: remove Section B, and give Section A to interviewee to return using Freepost envelope. Give opportunity for free comments now, and remind also of opportunity in Section A.

* please see note at start of Technical Annex 1

Technical Annex 2: ATC Glossary

<u>underlined terms</u> = distinct controller(s)

<u>AAC</u> [twr] [MAN = "Aerodrome Controller"]	Air Arrivals Controller = looks after last part of "final approach", i.e. a/c already on ILS and not intending to adjust direction. No further instructions to be passed from Final Director, so hand-off to AAC frees up the FD's frequencies. AAC is a *visual* (not radar) function, and not classified as part of approach control. Gives final clearance to land. Hand-off ➔ *GMC*. [Note. When volumes are low at LHR, AAC and ADC rôles combine to single rôle: "Air Controller"]
<u>ADC</u> [twr]	Air Departures Controller contacted as (runway) holding point approached, gives clearance to: enter active runway, line-up and take-off (hand-off ➔ TMA controller [for LHR = West Drayton, will clear through London Terminal Control Area]). Normally hand-off occurs before reach departure fix. West Drayton may actually pull off SID and give more direct vector. At FRA, a/c may be vectored directly to departure fix, w/o following SID.
AIC	Aeronautical Information Circular: official update to AIP, and usually incorporated into next edition of AIP [See also TOI and SI]
<u>APC</u> ('approach')	Approach Control - from reporting at Initial Approach Fix / arrival fix. This is start of "initial approach" (some texts refer to as "intermediate approach"). Complexity determined by configuration of airport and traffic volume (see also "straight-in") At LHR, approach vectoring by: - Intermediate Director North (Lambourne & Bovingdon) [has executive control over ID South] - Intermediate Director South (Ockham & Biggin) release from hold (usu. at MSL) and give initial descent clearance, producing 2 crude flows (hand-off ➔ Final Director) Final Director combines into 1 flow and turns onto ILS (hand-off ➔ AAC) When quieter, ID may vector onto ILS. At MAN, Approach Radar Control from 3 x stacks onto ILS (hand-off ➔ Aerodrome Controller)
arrival fix	= Initial Approach Fix
<u>arrivals</u>	= AAC (officially, *arrivals* = final part of *approach* procedures, although may be handled by controllers at a different location)
base leg	leg which follows downwind leg, usually at (appx.) 90° to it. See also base turn.
base turn	turn from downwind leg, onto base leg (note, however, that term 'base turn' is rarely used). The full sequence is as follows: downwind leg – base turn – base leg - 40° leg – final turn ('turn on') – establish on ILS
clean configuration	aircraft with zero-flap and gear up. Unless speed restricted, a/c can reach ILS from MSL whilst retaining a completely clean configuration, be that a stepped descent or CDA.

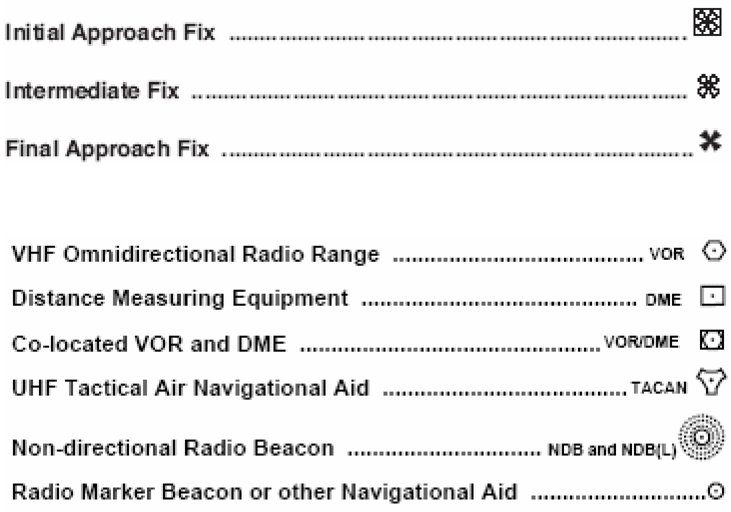
delivery	= GMP
departure fix	term not commonly used, but is reporting point at end of SID. Under control of *ADC* (but hand-off usually before end of SID).
departure radar	= APC [or APR (Approach Radar)]
departures	= ADC
direct(s)	= direct track(s). See RNAV.
'dive and drive'	e.g. when leaving MSL, ATC might clear a/c down to 3000ft to intercept ILS. Pilot could decide to attempt B-CDA, or at any point to 'dive and drive' straight down to 3000ft. A minimum rate of descent is specified in AIP but not always adhered to, unless ATC gave specific instruction such as 'descend to 3000 feet, leave 70 now'. (Note 'mixed' reference to *Flight Level* 70 and 3000 *feet* – see 'transition altitude'.)
DME	Distance Measuring Equipment (see also under ILS and VOR). Only gives straight line distances (i.e. from it to aircraft) so not (usually) of any use calculating remaining track distances during approach vectoring
en-route holding	does not appear to be a well-defined term, e.g. "en-route holding" used in UK AIP to label racetrack holds in intermediate part of STARs, although these can also just be labelled as "holding". May also be used to describe reducing airborne speed as a means of managing capacity, e.g. occurs in France for inbound CDG, and more strictly "en-route" (e.g. over Wales for inbound LHR/LGW (from North America), by 'flying between beacons', i.e. instructed to go back to previous beacon – could be 'called on' at any time by ATC. (NB holding configuration in a STAR may also happen to have two beacons in it, but usually fixed from just one). For racetrack holds, hold is usually (but not always) left at lowest level, i.e. descent clearance usually given from MSL. See also "holding".
final approach ('finals' / 'in the slot')	When a/c established on ILS. A/c is lined-up and is not intending to adjust direction. Could be 15-20NM out if a/c on a straight-in approach.
GMC [twr]	Ground Movement Controller looks after arriving a/c mvts once a/c clear of active runway, to stand, and then from pushback clearance to holding point for departures (hand-off ➔ *ADC*)
GMP [twr]	Ground Movement Planner will give start-up approval and SID (NB at LHR may actually be given SID during taxi-out) but not pushback clearance (hand off ➔ *GMC*)
ground	= GMC
holding	arrival management. Usually an "RNAV arrival route" (i.e. uses GPS) or a "linear holding" procedure (e.g. at FRA). Less commonly, stacks are used (e.g. LHR). See also "en-route holding".

ILS	= ground-based beacons giving two radio transmissions: - the 'localizer' = indicates centre-line of runway - the 'glide path' = beam angled at 3° to indicate correct angle of approach a/c 'lock' or 'establish' on ILS from last vector, which lines them up with ILS. For LHR, AIP AD-2-EGLL-8-1 notes that "ranging information is provided by <u>ILS-dedicated DME</u> facilities". If ILS fails, a surveillance radar approach may be provided by approach control, i.e. vectoring to mimic function of ILS, until cloud broken, then a visual approach is completed. A/c are usually established on the ILS at around 3000ft, but sometimes this will be further out (and higher), sometimes closer in (and lower). [N.B: CDA finishes at the point where the a/c is established on the ILS]
Initial Approach Fix (IAF)	reporting point at <u>end</u> of STAR (generally in UK, but not referred to as such at LHR). Under control of *approach*. Initial approach starts from here.
MSL	Minimum Stack Level (e.g. for four LHR holds, at end of STARs, usually FL70 or FL80, depending on QNH)
own navigation	a/c is said to be on "own navigation" when it is following chart headings between navigation beacons, or following a SID or STAR. See also "radar heading".
path stretching (or 'track stretching')	occurs during radar vectoring, e.g. between the IAF and the ILS. ATC may 'widen out' or 'tighten up' a heading (e.g. from 270º to 280º) and/or instruct an a/c to fly a longer track (e.g. an extended downwind leg), in order to avoid sequencing two a/c onto the ILS without the required separation. May be changed dynamically according to changes in wind and a/c responses to ATC instruction. When path stretching, ATC should ideally revise the track miles estimate to the pilot.
<u>planning</u>	= GMP
QNH	sea level atmospheric pressure. See also transition altitude.
radar heading	a/c is said to be on "radar heading" when it is being "vectored", as compared with on "own navigation".
reporting point	these may or may not be 'compulsory' reporting points (i.e. a/c must contact APC before reach) depending on particular flight and ATC instructions. Often coincide with VOR. // For LHR arrivals, Lambourne & Bovingdon (to north) plus Ockham & Biggin (to south), are sometimes described as 'the' four reporting points: all have warnings in AIP not to proceed beyond without reporting to ATC. Note, however, that actually these are the end points of STARs, with other reporting points 'up-route' in the STAR (but with no such reporting requirement actually stated on these reporting points, except when they act as alternates for end-points of the STAR). This suggests the term 'reporting point' (in UK AIP at least) should not be taken to indicate a compulsory reporting point. See also "significant point".

RNAV	Area Navigation. An increasing number of a/c now routeing on direct tracks instead of on the Upper Air Routes in the UIR (UIR in UK from FL245, rest of Europe typically FL245 – FL285, although some exceptions). GPS-based and allows a/c to track away from Upper Air Routes (i.e. away from between beacons). Increases capacity, may well save fuel.
significant point	intersection point with five-letter abbreviation, e.g. RADNO, TOLKA, DANDI, BEENO. No ground-based feature (e.g. beacon). NB. In UK AIP chart symobology [GEN 2.3] all of these are shown by white triangles, and designated as “reporting point” (the term “significant point” is not used). See also “reporting point”.
stack swapping	e.g. when primary stack at LAM is full, to send a/c to BIG. Secondary option is to use holding further back in the STARs.
standing agreement	e.g. whereby one sector always hands-off to adjacent sector at a given, pre-agreed flight-level
STAR	designator = final reporting point (at LHR, all = holding points) + letter code, e.g. BIG 3B, LAM 3A. Determined by international convention. Groups of STARs terminate (rather than begin) at a given point, e.g. “STARs via BIGGIN” all terminate at BIG VOR. UK AIP states standard routes may be varied at discretion of ATC, and each STAR has “descent planning” instruction, e.g. for BIG 3B = “FL150 by TIGER”, for most others = “as directed by ATC”. In UK, STARs often start as far out as UK boundary. No special term for start of STAR, and not usually a compulsory reporting point. STARs in UK terminate at IAF, often a co-located VOR and DME. STARs elsewhere in Europe finish at FAF.
straight-in	*approach* may vector a/c “straight-in” if get early enough before arrival fix (occurs rarely at LHR, e.g. very early in morning; more common at MAN).
SI	Supplementary Instruction: permanent amendment to Manual of Air Traffic Services (not part of AIP, but subject to it). [See also TOI and AIC]
THR	(e.g. in AIP charts) threshold of runway (= near end from perspective of landing direction). Could be an off-set marking on tarmac, i.e. not necessarily the start of the tarmac
TOI	Temporary Operating Instruction – temporary amendment to Manual of Air Traffic Services (not part of AIP, but subject to it). [See also SI and AIC]
transition altitude	height below which altitude is reference to QNH. If ATC instructs a descent from above the transition altitude, to below it, the altitude to which the a/c is instructed to descend is always given in feet, and the pilot informed of the QNH setting. Above the transition altitude, flight levels are used, based on standard atmospheric pressure (1013.25 millibar). (From 01 April 2005 the transition altitude will be standardised across the UK, to 6000 feet).
‘turn on’	turn from base leg onto 40º leg - see under base turn

vectoring	a/c is 'vectored' when following a (series of) heading(s) given by ATC, e.g. when not using a SID / STAR, or when not following chart headings between navigation beacons. Also referred to as a "radar heading". See also "own navigation". NB. the UK AIP defines, for example, the "Radar Vectoring Area" for "London Heathrow" [AD 2-EGLL-5-1].
VOR	VHF omnidirectional range – (radio navigation) beacon. Three-letter abbreviation. Note that often VORs and DMEs are combined, as in case of LAM/BNN/OCK/BIG.

Technical Annex 3: Extract from UK AIP GEN2.3 – Chart Symbols



Initial Approach Fix ....

Intermediate Fix ....

Final Approach Fix ....

VHF Omnidirectional Radio Range .... VOR

Distance Measuring Equipment .... DME

Co-located VOR and DME .... VOR/DME

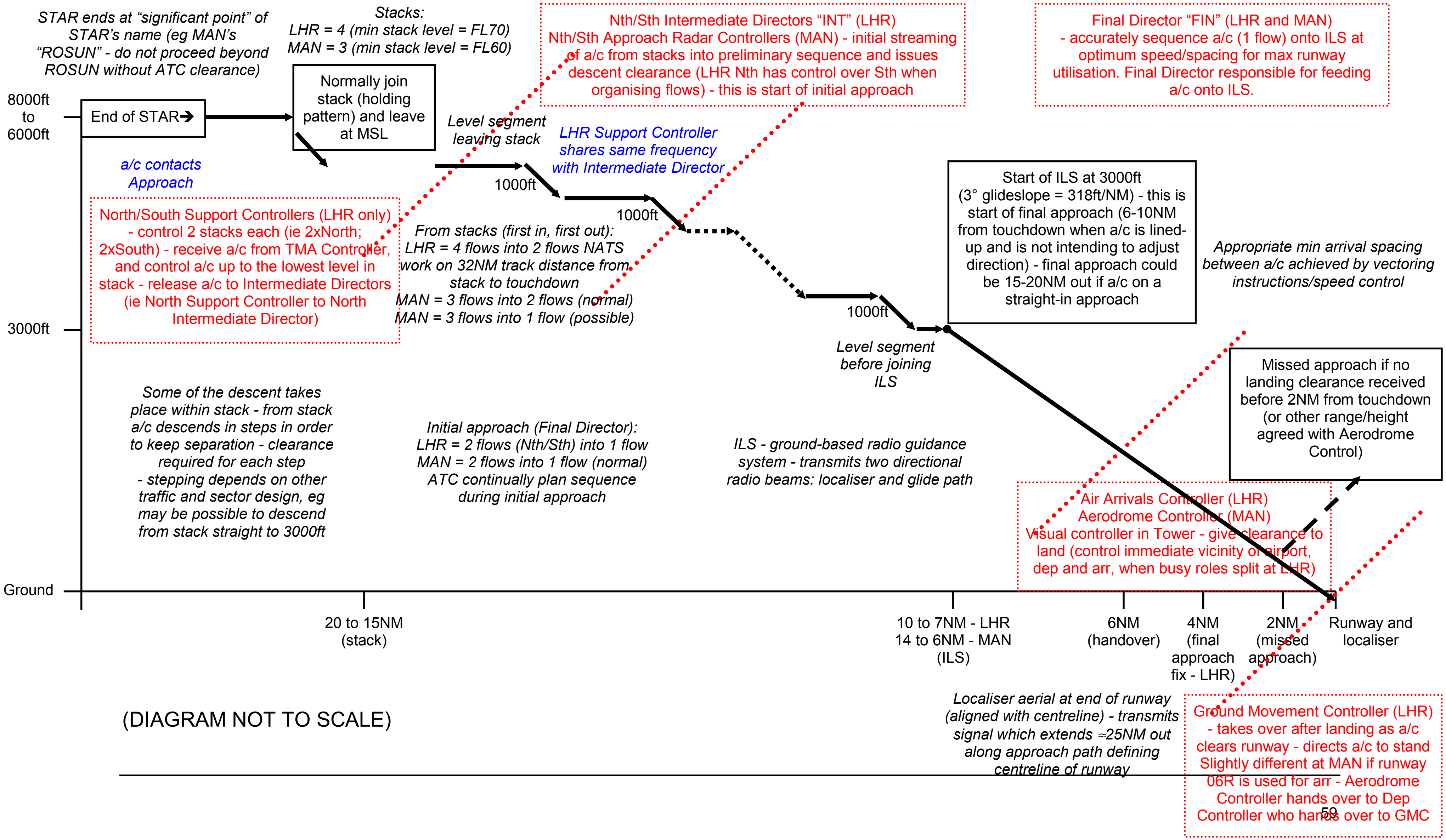
UHF Tactical Air Navigational Aid .... TACAN

Non-directional Radio Beacon .... NDB and NDB(L)

Radio Marker Beacon or other Navigational Aid ....

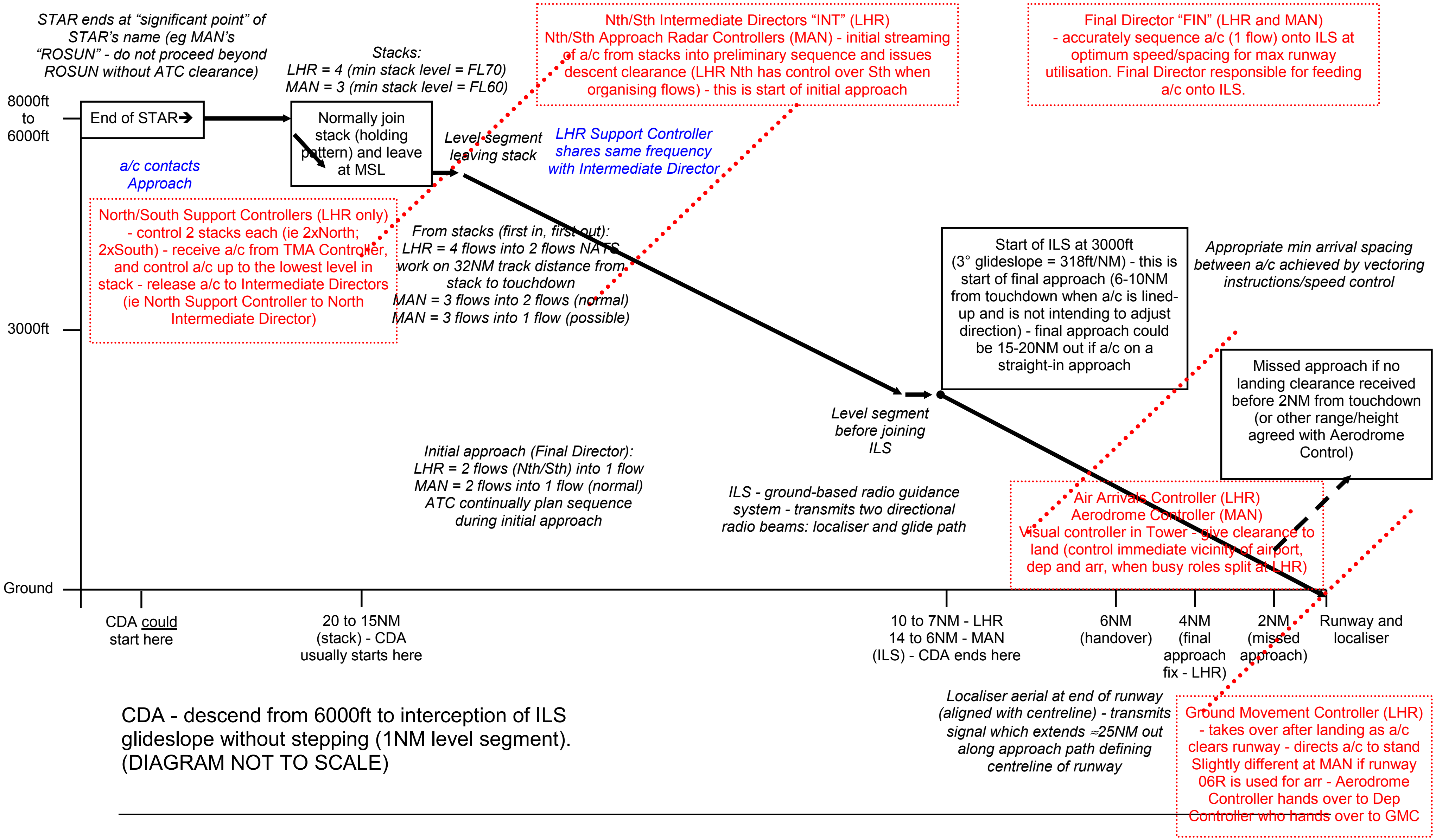
Technical Annex 4: Comparison of stepped/standard approach and B-CDA

UK Typical Arrival (Heathrow LHR and Manchester MAN primarily) - standard arrival rather than CDA



(DIAGRAM NOT TO SCALE)

UK CDA Arrival (Heathrow LHR and Manchester MAN primarily) - CDA arrival



CDA - descend from 6000ft to interception of ILS glideslope without stepping (1NM level segment). (DIAGRAM NOT TO SCALE)

Technical Annex 5: ATC Structure for Manchester – operational shifts

NATS Airport Services - Manchester

General Manager

Aerodrome	Area	Engineering	HR	etc

Separate functions, however focus on Aerodrome at Manchester

Aerodrome

Manager Air Traffic Control (Jon Proudlove)

Watch Managers (x5)

5 Watches, ≈10 controllers (approach and tower positions) per watch

"A"
"B"
"C"
"D"
"E"

Training Manager

Operations Manager (anything to do with operations e.g. a Royal Flight; sorts out changes to procedures)

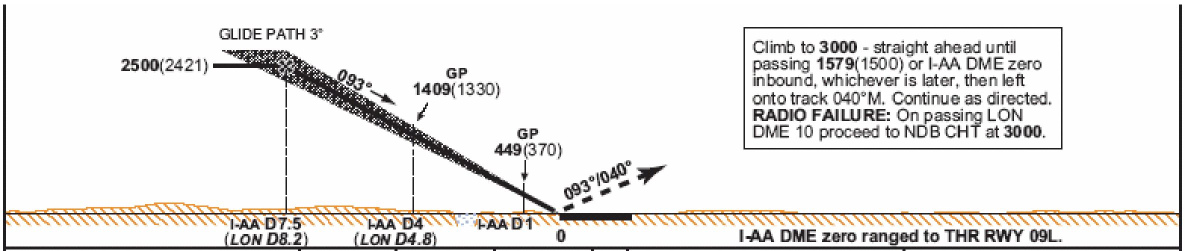
Example of "A" Watch - 10 day cycle for the ≈10 controllers

Watch	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
"A"	M	M	A	A	N	N	S	O	O	O
"B"	O	O	M	M	A	A	N	N	S	O
etc										

M=morning shift	*typically 8 work this shift; with 2 on leave*
A=afternoon shift	*typically 8 work this shift; with 2 on leave*
N=night shift	*only 4 work this shift; another 4 supplement other shifts (2 work morning; 1 works afternoon; 1 works "day late"); with 2 on leave*
S=sleep	*i.e. sleep all day to catch up*
O=off	*i.e. 3 days off at end of cycle*

Technical Annex 6: AIP extracts relating to ILS capture

London Heathrow (Extract from UK AIP AD-2-EGLL-8-1)



RECOMMENDED PROFILE			RATE OF DESCENT			OCA (OCH)		VM(C) OCA (OCH AAL)	
GLIDEPATH 3°, 320FT/NM						CAT I	CAT II	TOTAL AREA	
DME I-AA	ALT/HGT	G/S KT	FT/MIN						
4	**1409** (1330)	160	860		**A**	**227**(148)	**129** (50)	**583**(500)	
3	**1089** (1010)	140	750		**B**	**238**(159)	**140** (61)	**733**(650)	
2	**769** (690)	120	640		**C**	**252**(173)	**153** (74)	**833**(750)	
1	**449** (370)	100	540		**D**	**267**(188)	**169** (90)	**833**(750)	
		80	430						

AIRCRAFT UNABLE TO RECEIVE DME I-AA
Advise ATC . Equivalent radar ranges will be provided when established on the LLZ approaching the nominal FAF and 4NM points.

NOTES **1** Aircraft will normally be radar vectored from the STAR Holding/Initial Approach Fixes.
2 Ranging information is provided by ILS-dedicated DME facilities. DME values derived to the nearest 0.1NM from VOR DME LON are also provided for the FAF and 4NM check fixes.

Note small level segment at 2500ft prior to joining ILS, which ends at the Final Approach Fix. Referred to in procedural approach instructions in AIP.

Intentionally Blank

For more information about the EEC Society, Environment and Economy Research Area please contact:

Ted Elliff
SEE Research Area Manager,
EUROCONTROL Experimental Centre
BP15, Centre de Bois des Bordes
91222 BRETIGNY SUR ORGE CEDEX
France

Tel: +33 1 69 88 73 36
Fax: +33 1 69 88 72 11
E-Mail: Ted.Elliff@eurocontrol.int

or visit

http://www.eurocontrol.int/