FIXM Strategy

The Flight Information Exchange Model (FIXM) is an exchange model capturing Flight and Flow information that is globally standardised. The requirement for FIXM was identified by the International Civil Aviation Organisation (ICAO) Air Traffic Management Requirements and Performance Panel (ATMRPP) and endorsed at the 12th Air Navigation Conference as part of the Aviation System Block Upgrades (ASBU) and as described in Flight and Flow Information for a Collaborative Environment (FF-ICE).

This document details the strategic objectives for FIXM to guide the overall FIXM evolution.

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The authoritative reference for FIXM is www.FIXM.aero.

Details on Airservices Australia: http://www.airservicesaustralia.com/
Details on DSNA: http://www.developpement-durable.gouv.fr/-Navigation-aerienne-.html
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Document History

Version	Author	Description of Changes
1.0	FIXM CCB	First official release.
1.1	FIXM CCB	- New Appendix A detailing the FIXM Core vs FIXM Extension criteria - New Appendix B describing the applicable categorisation of FIXM extensions - Changes to chapters 1.1, 2.1, 2.2, 2.3, 2.4.2, 2.4.3, 2.5, 3.1. - Former Chapter 3 (V&V) is deleted

1. Introduction

1.1 Introduction to FIXM

The Flight Information Exchange Model (FIXM) is an exchange model capturing Flight and Flow information that is globally standardised. The requirement for FIXM was identified by the International Civil Aviation Organisation (ICAO) [1][2][3][4][5] Air Traffic Management Requirements and Performance Panel (ATMRPP) and endorsed at the 12th Air Navigation Conference as part of the Aviation System Block Upgrades (ASBU) and as described in Flight and Flow Information for a Collaborative Environment (FF-ICE) [6].

FIXM is the equivalent, for the Flight domain, of AIXM (Aeronautical Information Exchange Model) and WXXM (Weather Information Exchange Model) both of which were developed in order to achieve global interoperability for, respectively, AIS and MET information exchange. FIXM is therefore part of a family of technology independent, harmonized and interoperable information exchange models designed to cover the information needs of Air Traffic Management.

According to the ICAO SWIM concept [11], FIXM is one of the models that belong to the "Information Exchange Models" layer of the ICAO SWIM Global Interoperability framework.

1.2 Purpose of the document

This document details the strategic objectives for FIXM to guide the overall FIXM evolution.

1.3 Revision process

This document is approved and published by the FIXM Change Control Board (CCB). Future evolutions of the document shall be managed via the FIXM governance [10].

2. FIXM Requirements

This chapter lists the strategic requirements for FIXM. These requirements are expressed at a high level; they are expressed in order to ensure FIXM is developed according to a plan that is aligned with the expectations of the ICAO Aviation System Block Upgrades (ASBU) [7] and key FIXM stakeholders.

Interpretation

The operative verb "shall" is used for formal requirements. The operative verb "should" is used for recommendations. Formal requirements are mandatory and must be satisfied by FIXM. Recommendations are not mandatory; however, compliance is strongly advised, and non-compliance must be justified.

2.1 FIXM Governance principles

FIXM governance shall be established to manage the development of FIXM over time in order to:

- Ensure that FIXM is developed in a transparent manner.
- Ensure the standard strives to meet the needs of all FIXM stakeholders within the ATM community.
- Focus communication regarding FIXM development within the Aviation community.

The FIXM CCB shall provide this governance.

The FIXM charter [10] describes the principles of the FIXM governance, and the exact roles and responsibilities of the FIXM actors.

2.2 FIXM Components and Artefacts

FIXM is composed of the following main components:

- The **FIXM Logical Model** shall capture in UML all the constructs that are required for system-to-system exchange of flight information at a global level, including air-ground aspects, in a form that is technology-agnostic. It shall detail the data entities, their attributes and containment relationships. The FIXM Logical Model shall define an extension mechanism that allows data entities, attributes and relationships to be provided in addition to the core model. The presentation of the FIXM Logical Model shall not presuppose a specific physical model. The constructs defined in the core FIXM Logical Model shall be derived from, and traced to, the ICAO requirements for FIXM.
- A **FIXM Physical Model** is a realisation of the FIXM Logical Model defining a physical representation of the logical model to be used for data exchanges between systems (as messages/services - see chapter 3). A FIXM Physical Model shall represent constructs described in the FIXM Logical Model. The approved physical models are listed below.
    - The **FIXM XML Schemas** shall be a physical representation, expressed as a XML Schema Definition (XSD). Its use will primarily target ground-ground exchanges, as XML is not yet considered applicable for flight information exchanges between air (aircraft) and ground. The FIXM XML Schemas shall be programmatically derived from the FIXM Logical Model.

The term **FIXM** refers collectively to the FIXM Logical Model and all approved FIXM Physical Models and to the extensions managed by the FIXM governance as described in chapter 2.3.

FIXM may be expanded over time by including additional physical representations of the FIXM Logical Model (i.e. additional physical models). For instance, a physical representation of the FIXM Logical Model (or of a subset of it) supporting air-ground exchanges could be developed in the future and included in FIXM. Such additional physical representations of the FIXM Logical Model will officially qualify for FIXM if declared “FIXM compliant” by the FIXM governance (see chapter 2.1).

FIXM may also include additional artefacts associated with the main FIXM components, including, but not limited to:

- The **FIXM Primer**: this document shall serve as a high level introduction to FIXM, targeting the widest possible audience. It shall include references to the main FIXM components and to the FIXM materials listed below, including also the present FIXM Strategy document.
- The **FIXM HTML Documentation:** this is an online HTML description of the FIXM content targeting primarily the FIXM implementers. This documentation shall be derived programmatically from the main FIXM components.
- The **FIXM Operational Data Description**: The document shall list the main data items captured in FIXM and shall provide as a minimum their operational definitions, a list of acceptable synonyms and abbreviations, references to the ICAO requirements justifying their inclusion in FIXM, and the path to the corresponding constructs in the main FIXM components. This document is expected to serve as evidence that the content of main FIXM components satisfies, and is duly traceable to, the ICAO requirements.
- The **FIXM Implementation Guidance**: This package shall provide non-prescriptive guidance and clarifications about the use of the main FIXM components. It shall include technical recommendations for implementers that intend to develop technical services exchanging FIXM messages and a set of illustrative examples (see chapter 3). The guidance shall also include an **ATS Message to FIXM Logical Model mapping** providing a mapping between the FIXM Logical Model and ICAO Air Traffic Services messages as defined in ICAO Doc 4444 [8].

This mapping will serve as evidence that a FIXM release remains compatible with the content of ICAO ATS Messages (see chapter 3.1).

- The **FIXM Development Guidelines**: This package shall provide principles, rules and recommendations for developing and maintaining the main FIXM components, and for creating extensions. It shall provide in particular guidelines for the construction of the main FIXM components so that interoperability with existing standards and legacy systems is ensured during the period of transition to FF-ICE. This document shall be a basis for assessing the quality of the main FIXM components.
- **FIXM Supporting Tools and Guidance**: These are automation tools developed and used to support the development of the FIXM XML Schemas, including extensions to the core schemas. These tools should be delivered together with supporting documents such as user manuals (e.g. FIXM Logical Model to XML schemas mapping rules).
- The **FIXM Conceptual Model** will model in the Unified Modelling Language (UML) the operational language used to describe the flight and flow information exchange aspects required by the concepts of operations supported by FIXM (as a minimum, the operational language defined in the FF-ICE provisions). It shall capture the operational entities and their relationships and shall be expressed in terms understandable by operational stakeholders. Traceability between the FIXM Conceptual Model and FF-ICE shall be realised.

For practical reasons, the evolution of FIXM will necessitate the update and recognition of these components in a managed fashion by the use of recognised releases.

2.3 FIXM Core and Extensions

FIXM, like AIXM and WXXM [9], shall support a "core + extension" mechanism, and should comply with the core and regional extension concept of ICAO Document 9965.

- The core part shall contain the pieces of flight information that are globally applicable and which are endorsed by the FIXM CCB. At minimum this shall include the scope of the FF-ICE provisions.
- The extensions will supplement the core FIXM model in order to support additional (e.g. regional) requirements from particular communities of interest. An extension will add elements beyond the core provisions but shall never supersede those of the core.
- The extensions may serve as an operational "incubator" prior to being "promoted" to the core.

Appendix A – "Core vs extension" criteria for FIXM details the criteria for unambiguously deciding whether given pieces of information qualify for FIXM core or for FIXM extensions.

Supporting extensions to a FIXM core model is paramount in order to:

- Enable Communities of Interest to capture application-specific requirements, without undermining global interoperability of flight information exchanges;
- Support the interface between implementers of different versions of FIXM;
- Facilitate the Change Management Process of FIXM.

Proliferation of FIXM extensions should be avoided in so far as a FIXM core reduced to the minimum but with a myriad of regional extensions would fail to enable global interoperability for the Flight domain. The FIXM extensions will be managed in a transparent manner by the FIXM governance. Appendix B - Categorisation of FIXM extensions details the applicable categorisation of FIXM extensions with their associated levels of governance.

Extensions shall address as a minimum the logical and physical aspects with respect to:

- An entity that is of value to multiple (not necessarily all) regions, and its incorporation would facilitate the integration of FIXM into the stakeholders' operations. Such extensions would map to the regional extension concept described in FF-ICE [6].
- An entity the CCB considers being of generic utility. It may not be in widespread use at the time of its inclusion in FIXM, but the expectation is its use would become widespread.

Any entity that is incorporated as an extension could be proposed to ICAO for formal inclusion in the ICAO requirements. If endorsed by ICAO, the data entity would move to the core, so that ICAO compliance of FIXM core is retained. An extension may therefore serve as an operational incubator prior to being promoted to the core.

2.4 FIXM, one of many ATM standards

Many initiatives have been historically conducted by various ATM communities of interest in order to specify standards supporting the exchange of domain-specific information. ATM modernisation programmes are now moving towards integrated ATM information where these existing standards, developed to meet domain-specific requirements, have to be brought together and aligned to a certain extent.

FIXM, in this context, is one ATM standard, among many others, that will enable the exchange of elements of ATM information, restricted to the Flight domain. Its development shall therefore be aligned with other relevant ATM initiatives.

This chapter lists a number of strategic requirements for FIXM with regards to the alignment and connection with other ATM standard developments.

2.4.1 AIXM, WXXM and FIXM

The AIXM (Aeronautical Information Exchange Model) is designed to enable the management and distribution of AIS (Aeronautical Information Services) data in digital format. More information about this data exchange model can be found in the website www.AIXM.aero.

The WXXM (Weather Information Exchange Model) is designed to enable a platform independent, harmonized and interoperable meteorological information exchange covering all the needs of the air transport industry. More information about this data exchange model can be found in the website www.WXXM.aero.

FIXM (Flight Information Exchange Model) is designed to enable the interoperability of flight and flow information at a global level.

FIXM may overlap in scope with the AIM and MET domains. FIXM shall therefore be able to reference AIXM and WXXM when deemed relevant, and shall not redefine their content items[1].

FIXM shall rely, as much as possible, on the same foundations as AIXM and WXXM, in order to allow greater interoperability between different ATM data domains. These common foundations may include:

- Standards from the ISO 19100 series, such as GML;
- OGC standards and best practices.

2.4.2 FIXM and AIDX

The International Air Transport Association (IATA) (http://www.iata.org) has established the Passenger and Airport Data Interchange Standards (PADIS) Board to develop Electronic Data Interchange message standards and also XML message standards for passenger travel and airport-related passenger service activities. One component of this project is AIDX, the Aviation Information

[1] FIXM, AIXM and WXXM need to be semantically consistent.

Data Exchange, which is being used by ACI Airport Community Recommended Information Services (ACRIS) for Airport Collaborative Decision Making (A-CDM).

FIXM may capture pieces of flight information also captured in AIDX; therefore, FIXM shall be at least semantically consistent with AIDX, in case of an overlap of information.

2.4.3 FIXM and the (future) ICAO AIRM

ICAO endorsed during the 12th Air Navigation Conference the creation of an ATM Information Reference Model (AIRM) acting as an overarching reference for the ATM domains: Flight, AIM, MET, Surveillance etc.

The exact content in terms of scope of the ICAO AIRM is currently being clarified, and it is possible that the ICAO AIRM will ultimately impact on the FIXM development in relation to SWIM [11] activities within ICAO (e.g. need for compliance at the semantic level). It is therefore recognised as a strategic objective for FIXM to monitor the future evolution of the ICAO AIRM and to align as soon as possible these future ICAO developments and FIXM.

More generally, it is recognised as a strategic objective for FIXM to monitor the work and conclusions of the ICAO Information Management Panel (IMP) with regards to Information Management, SWIM Governance and ATM messaging and to align FIXM with any relevant recommendations from this panel, as appropriate.

2.5 FIXM Scope and Schedule

It is the role of the FIXM CCB to produce the FIXM Release Plan which:

- Provides the scope / content of FIXM;
- Details the FIXM implementation/evolution timelines;
- Balances expectations of system implementations.

The main intention is to achieve information exchange interoperability between stakeholders for all phases of flights and types of operations, but it does not preclude any beneficial usage within the stakeholders' environment. The expectations are that ICAO would look to focus on the global expectations whilst allowing more advanced regional developments.

The FF-ICE concept and the applicable ICAO provisions drive the common and international development of FIXM, and impose requirements on what FIXM will deliver. FIXM shall aim to provide full coverage for FF-ICE. The scope of FIXM can however go beyond the strict provisions for FF-ICE if approved by the FIXM governance.

The scope of an individual release of FIXM (core and extensions) is decided by the FIXM CCB prior to the development, under the supervision of ICAO ATMRPP. The availability of operational inputs will drive the development of a given FIXM version. The FIXM CCB will provide the de facto focal point for collecting such operational drivers, unless other working arrangements are approved by the FIXM CCB and duly described in the FIXM CCB charter.

3. FIXM Relationship to Services and Messages

The ICAO SWIM concept [11] chapter 3 introduces *a five-layered SWIM Global Interoperability Framework to describe the sharing of information via SWIM*, the scope of SWIM being limited to three layers and related governance: Information Exchange Services, Information Exchange Models and SWIM Infrastructure.

FIXM is one component belonging to the *Information Exchange Models* layer. FIXM only gives identification of, and provides standardisation for the content of, the information elements that the stakeholders need to exchange at various times. How these information elements are then packaged

and used - in terms of services, or defined message exchanges, between the stakeholders - is not, according to the ICAO SWIM concept, within the formal scope of FIXM.

However, FIXM shall be designed in order to enable the exchange of flight and flow information as prescribed by the ICAO FF-ICE concept, and shall therefore be optimised for use by the FF-ICE services. FIXM will therefore be directly influenced by service, or message, considerations – i.e. how related FIXM elements may be packaged together, or grouped with other elements that are exchanged between stakeholders at the same time, as prescribed by ICAO.

The FIXM Implementation Guidance (see 2.2) provides non-prescriptive guidance and clarifications about the use of the main FIXM components in support of FF-ICE, including messaging & service aspects[2] in line with the FF-ICE Implementation guidance developed by ICAO ATMRPP. Because service considerations are not formally in the scope of FIXM, such guidance shall be released as recommended practice for FIXM and shall not be prescriptive.

3.1 ATS Messages

Whilst Services may be viewed as the way ahead, in particular by the ICAO FF-ICE concept, there is expected to be a significant period in which systems will still fully, or partially, use ATS Messages, and so translation between Messaging and Service provisions will also be needed.

Historically, FIXM was developed based on the content elements within the ICAO 4444 ATS Message set. Whilst ICAO messages remain in use, there would be significant risks were there to be differences in the elements and content provisions existing within the ICAO messages and those being developed and provided within FIXM.

While these messages remain in use, FIXM will need to ensure it retains and releases content that remains compatible with these approved ICAO standard ATS Messages. That is, FIXM will need to ensure ICAO flight information content can be translated to, and from, FIXM encoded forms without any loss of the message content details.

However, whilst needing to retain compatibility with the ICAO standard ATS Message content, and also maintaining alignment should the ATM message contents be revised, FIXM will need to ensure it is not constrained to just meeting such message based needs and is thus also able to provide the additional and enhanced content needs for the evolving ATM needs, in line with ICAO requirements.

[2] This guidance might elaborate on other FIXM usages beyond FF-ICE, if considered relevant by the governance for FIXM.

4. References

[1] Global Air Traffic Management Operational Concept (First Edition - 2005), ICAO Doc 9854

[2] Manual on Air Traffic Management System Requirements (First Edition – 2007), ICAO Doc 9882

[3] Global Air Navigation Plan (Fourth Edition – 2013), ICAO Doc 9750

[4] Manual on Global Performance of the Air Navigation System (First Edition – 2008), ICAO Doc 9883

[5] Manual on Collaborative Air Traffic Flow Management (First Edition – 2012), ICAO Doc 9971

[6] Manual on Flight and Flow Information for a Collaborative Environment (First Edition – 2012), ICAO Doc 9965

[7] ASBU Working Document, (Edition 2, Version 3)

[8] Procedures for Air Navigation Services: Air Traffic Management, ICAO Doc 4444, 15th Ed

[9] Introduction to Aeronautical Information Exchange Model (AIXM) / Weather Information Exchange Model (WXXM) / FIXM Extensions, ICAO ATMRPP WP520

[10] FIXM Change Management Charter, version 1.1

[11] Manual On System Wide Information Management (SWIM) Concept, (Advanced Edition – 2015), ICAO Doc 10039

Definitions

A-CDM	Airport Collaborative Decision Making
ACRIS	Airport Community Recommended Information Services
AIDX	Aviation Information Data Exchange
AIRM	ATM Information Reference Model
AIS	Aeronautical Information Services
AIXM	Aeronautical Information Exchange Model
ASBU	Aviation System Block Upgrade
ATMRPP	Air Traffic Management Requirements and Performance Panel
CCB	Change Control Board
FF-ICE	Flight and Flow – Information for a Collaborative Environment
FIXM	Flight Information Exchange Model
GML	Geography Markup Language
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IMP	Information Management Panel
ISO	International Standards Organisation
OGC	Open geospatial Consortium
PADIS	Passenger and Airport Data Interchange Standards
SWIM	System Wide Information Management
UML	Unified Modelling Language
WXXM	Weather Information Exchange Model
XML	Extensible Markup Language
XSD	XML Schema Definition

* * *

Appendix A – "Core vs extension" criteria for FIXM

The information identified as globally applicable by ICAO FF-ICE [6] shall feed into the core FIXM, as stated in chapter 2.3. The criteria elaborated in this appendix clarify the expectations towards:

- Any ICAO FF-ICE regional requirements;
- Any ICAO requirements not originating from the ICAO ATMRPP;
- The requirements not originating from ICAO but from other community of interests.

ICAO FF-ICE regional requirements

ICAO FF-ICE [6] specifies requirements for Flight and Flow Information exchanges. *Definitions of information elements for the FF-ICE are globally standardized.*

ICAO FF-ICE [6] states however that not all information elements may be applicable globally, and recognises that *Regional variation required for performance reasons will be implemented by use of different subsets of the standard information elements. New elements will be introduced regionally through regional extensions as needed but will not be mandatory for other regions, will not provide duplicate information of existing elements, and should be intended to become part of the global standard.*

ICAO FF-ICE [6] Figure 3-1 provides a graphical illustration of this environment.

Other ICAO requirements

ICAO may develop additional concepts of operations that FIXM could support, such as the ICAO A-CDM concept whose development is underway.

Therefore, ICAO requirements not originating from the ICAO ATMRPP, but laid down by other ICAO panels, may be considered as drivers for FIXM.

Other stakeholders' requirements

While ICAO FF-ICE provides the main driver for FIXM, some stakeholders may have additional Flight and Flow Information exchange requirements that could possibly be satisfied by FIXM. In other terms, non ICAO requirements might be considered for FIXM.

Among these non ICAO requirements, some may still prove to be globally applicable, while others may remain applicable to (a) specific region(s).

"FIXM Core vs FIXM extensions" criteria

The following criteria are applicable for unambiguously deciding whether particular pieces of information qualify for FIXM core or for FIXM extensions.

- The ICAO FF-ICE Information Requirements applicable only at regional level[3] are not supported by FIXM Core.
- FIXM supports primarily the ICAO FF-ICE concept, but may satisfy other requirements laid down by other ICAO panels or groups.
- ICAO is the only international organisation having the authority to define concepts of operations that are harmonised and applicable at global level. Therefore, FIXM core contains only those elements that can ultimately trace to ICAO developments.

[3] Regional level means indifferently "one region" or "2 or more regions".

This translates into the following table:

	ICAO						Non-ICAO		
	FF-ICE Information Requirements			Other Information Requirements			Non-ICAO Information Requirements		
	Global	Regional *(1 region)*	Regional *(2 or more regions)*	Global	Regional *(1 region)*	Regional *(2 or more regions)*	Global	Regional *(1 region)*	Regional *(2 or more regions)*
FIXM Core	**CORE**			**CORE**					
FIXM Ext.		**EXT**	**EXT**		**EXT**	**EXT**	**EXT**	**EXT**	**EXT**

The consequences of these criteria are the following:

- At the level of the FIXM governance, the FIXM CCB should seek to engage with other ICAO panels that could possibly use FIXM as a technical solution in support of their concepts of operations.
- At the technical level,
  - Data elements not related to the FF-ICE package, and more generally not supported by any ICAO provisions, are out of FIXM core scope, and accommodated in one or more extensions.
  - FIXM extensions will be used for satisfying regional requirements (one region or 2 or more regions).
  - A new categorisation of extensions is required in order to distinguish extensions focusing on regional requirements, extensions supporting global requirements not yet traceable to ICAO etc… A different level of governance for extensions is also needed.

Appendix B - Categorisation of FIXM extensions

Appendix A sets the criteria for unambiguously deciding whether particular data elements qualify for FIXM core or for FIXM extensions. According to these criteria, elements qualifying for FIXM extensions will include, among others:

- Data elements supporting the ICAO FF-ICE Information Requirements applicable only at regional level;
- In general, data elements potentially applicable at global level but not required yet in FIXM Core, based on the criteria elaborated in Appendix A;
- Data elements supporting research concepts for which global convergence still has to be achieved;
- Data elements satisfying specific needs of one particular stakeholder and not directly relevant to the FIXM community.

Because of the diverse nature of the data elements qualifying for FIXM extensions, a categorisation of extensions is required with appropriate governance processes. The following categorisation of extensions is applicable.

Verified Extensions

- A verified extension is an extension to core FIXM that is subject to governance processes equivalent to that of the core. The release of a verified extension is subject to FIXM CCB endorsement.
- Verified extensions will be created in order to support regional requirements prescribed by ICAO FF-ICE [6] or by any other relevant ICAO inputs.
- Verified extensions can also be created in order to support information exchange requirements whose applicability at global level is foreseen but not yet demonstrated, such as for lack of maturity. These extensions would typically serve as operational incubator for new concepts.
- The promotion of data elements from a verified extension to FIXM core is realised when the corresponding information exchange requirements become globally applicable. *Example: FF-ICE requirements first introduced regionally but becoming part of the global concept would trigger a movement of data elements from corresponding verified extensions to FIXM core.*
- The identification of potentially overlapping content between verified extensions will help trigger the necessary harmonisation of the information exchange requirements at global level.
- Verified extensions may also be created in order to facilitate the interface between implementers of different FIXM versions.
    - When a new core FIXM version v.(n) is released, early implementers of this new version may still have to interface with systems based on a previous version v.(n-1). An extension to core v.(n-1) could be developed in order to capture (a subset of) the new capabilities introduced by v.(n), thus enabling the users of v.(n-1) to progressively support new concepts introduced by v.(n) without having to invest immediately in a full upgrade of their systems.
    - These particular extensions, which are of technical nature only, qualify for verified extensions as subject to endorsement by the FIXM governance.

Other Extensions

- Extensions to FIXM core which do not qualify for verified extensions are not subject to supervision and endorsement by the FIXM governance. Any FIXM stakeholder, regardless of its involvement in the FIXM governance, can develop such an extension.
- A FIXM stakeholder having local extensions may consider some of the data elements suitable for FIXM core. A FIXM stakeholder may therefore raise change requests to propose inclusion of data elements from their local extensions, in accordance with the change management process described in [10].
- Maintaining an overview of existing FIXM extensions is paramount for mitigating the risk of extensions' proliferation. This will be achieved at least for verified extensions. The FIXM governance should also encourage and facilitate the sharing of information about non-verified extensions that organisations may develop over time for their internal use.

The diagram below further illustrates the applicable categorisation of extensions.

Note: The examples of FIXM extensions used in the picture are illustrative; the picture does not imply that these particular extensions will be effectively required and developed.