

Industrial automation: shop floor production —

Part 2: Application of the reference model for standardization and methodology

Committees responsible for this Draft for Development

The preparation of this Draft for Development was entrusted by the Advanced Manufacturing Technology Standards Policy Committee (AMT/-) to Technical Committee AMT/5, upon which the following bodies were represented:

- British Computer Society
- Department of Trade and Industry
- EEA (The Association of Electronics, Telecommunications and Business Equipment Industries)
- Gauge and Tool Makers' Association
- Institution of Electrical Engineers
- Institution of Manufacturing Engineers
- Institution of Mechanical Engineers
- Machine Tool Technologies Association

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National foreword

This Draft for Development is published in two Parts. This Part of DD 203 has been prepared under the direction of the Advanced Manufacturing Technology Standards Policy Committee and is identical with Technical Report ISO/TR 10314-2:1991 *“Industrial automation — Shop floor production — Part 2: Application of the reference model for standardization and methodology”*.

This Draft for Development presents and describes a means of identifying where new or revised standards may be required. It establishes a reference model for shop floor production, which is then used as a basis for developing a methodology for the identification and extraction of areas for standards.

This Part of DD 203 should be read in conjunction with DD 203-1:1991 *“Industrial automation: shop floor production — Part 1: Reference model for standardization and a methodology for identification of requirements”*. It deals with the general application of the reference model and methodology to the general area of shop floor production standardization. Its aim is to identify potential shop floor industrial automation standards.

The UK actively participated in the development of ISO/TR 10314-1 and ISO/TR 10314-2 through BSI Technical Committee AMT/5 and ISO Technical Committee ISO/TC 184.

International and European Standards, as well as overseas standards, are available from BSI Sales Department, BSI, Linford Wood, Milton Keynes MK14 6LE.

Information on the availability of developing and published International and European Standards, as well as up-to-date information on existing and projected British Standards publications in the general area of information technology, is included in the “BASIC LIST” and regular Newsletter published as part of the BSI Information Technology Service (BITS) initiative. For details of the BITS scheme, contact Mr Julian Bogod, 205 Holland Park Avenue, London W11 4XB.

This publication is not to be regarded as a British Standard

It is being issued in the Draft for Development series of publications and is of a provisional nature because the subject matter is still under technical development requiring wider exposure. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

Reviews of Drafts for Development are normally carried out not later than two years after publication. In the case of this DD, however, review is unlikely to occur independently of the international review of ISO/TR 10314-2. Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development, will be made in an announcement in the appropriate issue of *BSI News*. According to the replies received, the responsible BSI committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.

Observations which it is felt should receive attention before the official call for comments will be welcomed. These should be sent to the Secretary of the BSI Technical Committee AMT/5 at the BSI London address as shown on the back cover.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 49 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

Technical Report 10314 — Reference Model for Shop Floor Production Standards has been issued as two parts. Part 1 of TR 10314 (hereinafter referred to as “Part 1”) describes “A Reference Model for Standardization and a Methodology for Identification of Standards Requirements” for industrial automation. The enclosed Part 2 deals with the “Application of the Reference Model and Methodology” to the general area of industrial automation shop floor production standards. Additional parts of TR 10314 may be developed to further focus the model and methodology described in Part 1 to specific areas of technology or application. The need for additional parts to TR 10314 has yet to be determined.

The goal of Part 2 of TR 10314 is to identify potential areas for shop floor production industrial automation standards. Part 2 of TR 10314 consists of this introduction and six chapters. Chapter 1 defines the Scope of this project and it is similar to that provided in Part 1. Chapter 2 discusses in detail the matrix concept presented in Part 1, and presents the classifications and criteria used to provide the headings for the rows and columns of the matrices. The procedures used to identify the individual boxes within a matrix are also presented. A more detailed guide to using these procedures is provided in Chapter 3. Chapter 4 uses the reference model and the methodology to identify areas of standardization. Finally, Chapter 5 is a review of the recommendations that were derived during this exercise of the reference model.

It should be noted that the Reference Model defined in Part 1 of TR 10314 can be used to identify potential areas of standardization, and also as a cataloging system to compile standards that apply to a given area. This document exercises the reference model to identify and catalog industrial automation standards at the level of International Standards. Via this exercise, the overlap between potential areas of standardization, and existing standards and/or standards projects could be analyzed. What the model can not provide is a mechanism to assign priorities to potential areas of standardization. Priorities, in terms of the need for International Standards, are dependent upon many factors including: perceived need, resources available, and alternative solutions. A number of ranking systems exist to quantify these, and other factors, to develop a prioritisation of potential standard work. The Working Group developing the Reference Model felt that the prioritisation of projects is best left to the member bodies of ISO.

National bodies and other international organisations may wish to use this model to catalog their existing industrial automation standards and standards projects. Via this exercise, they may obtain direction with respect to areas where national standards may be used as the basis for ISO or IEC new work items. In addition, they will be able to identify areas of work that are not covered by either national or international projects. These “gaps” may be ideal areas to focus new standards projects.

As indicated, the results of this work identify potential areas of standardization, and provide a means to catalog existing standards and standards projects. The model does not provide a means to design industrial automation systems, and it does not indicate whether the standards within a given area are sufficient for all areas of application. The design of a system, and the adequacy of a standard, or a set of standards, are application specific and can not be dealt with at this time with a general modelling construct.

1 Scope

This report presents and describes a means of identifying where new or revised manufacturing standards may be required. It establishes a Reference Model for Shop Floor Production, which is then used as the basis for developing a methodology for the identification and extraction of areas for standards. The assumptions used to develop the Reference Model are:

- the field of interest is the manufacture of discrete parts and in particular the production (physical realisation) of these parts,
- the Reference Model needs to be open-ended so that it can be revised to incorporate new technologies, and
- the Reference Model needs to be generic in nature so that it can be applied to a wide range of applications and is not directed to a particular organisational structure of manufacturing.

It is emphasised that the Reference Model:

- provides a conceptual framework for understanding discrete parts manufacturing and
- can be used to identify areas of standards necessary to integrate manufacturing systems.

The Reference Model does not however provide a methodology for designing, implementing, operating and maintaining any existing or future manufacturing automation system. There may be a need to develop other Reference Models which can be used for those purposes, perhaps based on the work described in this report. The development of such models is beyond the scope of this technical report.

2 Methodology for identification of areas of standards

Procedures for using the reference model, a methodology, are needed for a guide on how to use the reference model, how to identify areas for standardization and subsequently how to derive areas of standards requirements. These procedures are described in detail in the “Reference Model for Manufacturing Standards, Part 1”, and are summarised below.

2.1 An overview of the reference model

Discrete Parts Manufacturing has been represented by twelve major functions. These are:

1. Corporate Management
2. Finance
3. Marketing & Sales
4. Research & Development
5. Product Design & Production Engineering
6. Production management
7. Procurement
8. Shipping
9. Waste Material Treatment
10. Resources management
11. Maintenance Management
12. Shop Floor Production

The Reference Model described here concentrates on the last of these twelve functions, Shop Floor Production, and its environment or Context Functions, which constitute the first eleven functions. Shop Floor Production is the primary function directly engaged in producing parts.

Shop Floor Production is represented in Part 1 by a four level Shop Floor Production Model or SFPM. It is quite likely that specific manufacturing implementations may require more or less than four levels, but four levels seem sufficient for the purpose of identifying areas of standards. The four levels of activity are as shown in Figure 1 (reproduced from Part 1), namely:

- Level 1 Equipment.
 Execute shop floor production processes.
- Level 2 Station.
 Command shop floor production processes.
- Level 3 Cell.
 Coordinate shop floor production processes.
- Level 4 Section/Area.
 Supervise shop floor production processes.

	Level	Sub-Activity	Responsibility
4	Section/Area	Supervise shop floor production process	Supervising and co-ordinating the production and supporting the jobs and obtaining and allocating resources to the jobs
3	Cell	Co-ordinate shop floor production process	Sequencing and supervising the jobs at the shop floor production process
2	Station	Command shop floor production process	Directing and co-ordinating the shop floor production process
1	Equipment	Execute shop floor production process	Executing the job of shop floor production according to commands

Figure 1 — Shop Floor Production Model (SFPM)

A Generic Activity Model or GAM has been developed to model the execution of the various activities at each of the four levels, as shown in Figure 2 (reproduced from Part 1). The internals of the GAM represent an interrelated set of four subjects and four actions.

The four subjects are:

a) **Control Information** which includes:

- i) command information, normally flowing from a higher level to a lower level, which initiates, alters or terminates an activity,
- ii) status information which is generated in direct response to a command and normally flows in the opposite direction to the command,
- iii) request information which corresponds to control information for control interaction within a level (peer to peer), if any, and
- iv) response information which corresponds to status information for control interaction within a level (peer to peer), if any.

b) **Data:** all information other than control information required for or resulting from the performance of an activity.

c) **Material:** Material is a production object of the manufacturing activity. Material includes all the physical matter that enters the product during manufacturing: raw materials, parts and assemblies, auxiliary materials, products and scrap material.

d) **Resources:** Resources are all the physical means required to carry out the manufacturing that are not Material. Resources include transform, transport, verify and storage equipment; tools and fixtures; data processing and communication systems; software; basic resources such as supply material, energy, space and time; and personnel.

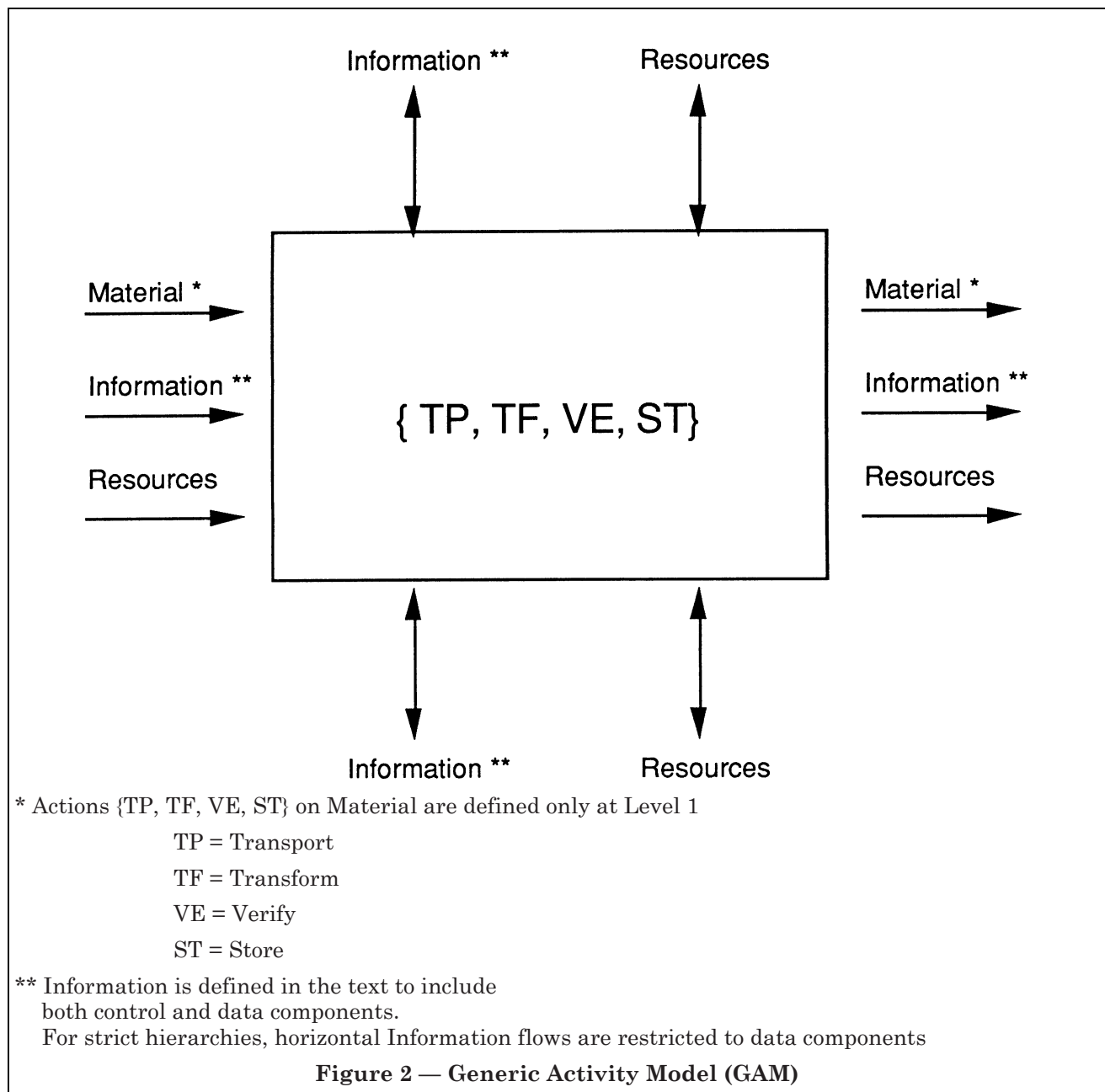
The four actions are:

a) **Transform:** The act of changing control information, data, material or resources from one form to another form, or one state to another state. Transform includes encoding or parsing information, decomposing commands, and cutting, forming, assembling, or adjusting material or resources.

b) **Transport:** The act of moving control information, data, material, or resources from one point in the enterprise to another.

c) **Verify:** The act of assessing the compliance of all transformed control information, data, material and resources to determine their conformance to a specification.

d) **Store:** The act of retaining control information, data, material or resources at a specified location within Shop Floor Production until they are required to be transported.



For each activity, these procedures should be applied to extract areas where standards may apply.

Procedure A1: **Subject-Action** interrelationship

For each activity in each level of the SFPM, consider any possible Subject-Action interrelationship for applicable areas of standards.

Procedure A2: **Subject** interrelationship

For each activity in each level of the SFPM, consider any possible Subject-Subject interrelationship for applicable areas of standards.

Procedure A3: **Action** interrelationship

For each activity in each level of the SFPM, consider any possible Action-Action interrelationship for applicable areas of standards.

Procedures B: the “External” procedures

These procedures are used for extracting areas of standards for interrelationship between activities of the subjects of Shop Floor Production and its manufacturing context in both a vertical (between levels) and contextual (horizontal, on the same level) structure.

For each activity these procedures should be applied to extract areas where standards may apply.

Procedure B1: **Horizontal** (Contextual) interrelationship

Consider any possible interrelationships between activities between the subjects of Shop Floor Production and its manufacturing context for applicable areas of standards.

Procedure B2: **Vertical** interrelationship

For each level of the SFPM consider any possible Subject interrelationship with the levels above and below for applicable areas of standards, and hence relevant Subject attributes. Note that there is no level to be considered below level 1, while the context functions should be considered as forming the level above level 4.

For each of these procedures matrices are developed in chapter 3 whose elements correspond to areas for standardization, and which can be populated by applying the procedures above.

2.3 Classification of areas for standards

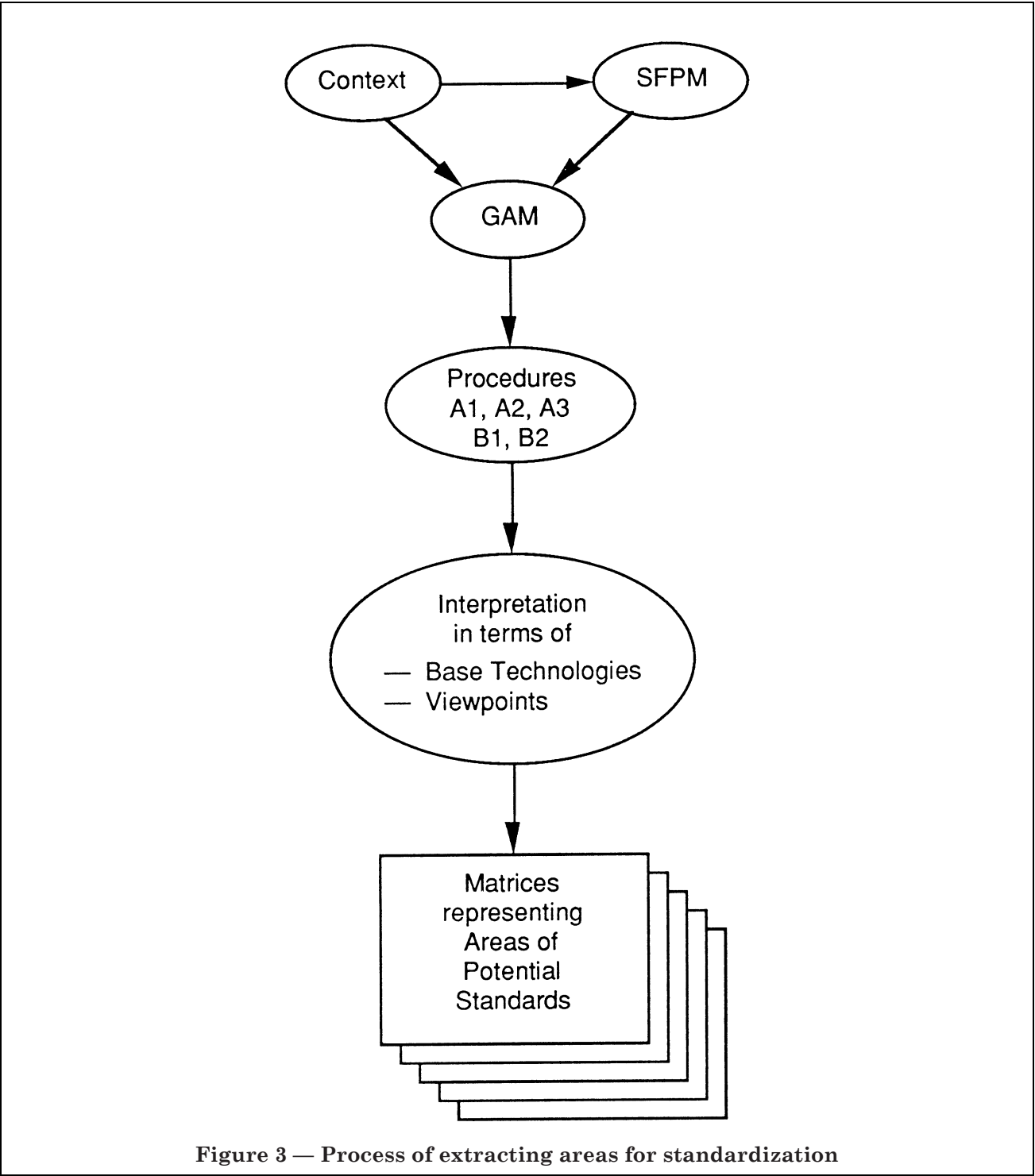
Part 1 of the Reference Model introduced an overall approach to identifying areas for standards (in Figure 5 of that document). However when extracting areas for standardization it is necessary to interpret the identified areas in terms of relevant technologies, and in terms of the qualities desired from the standards. The following Figure 3 shows how the general issues raised by the Procedures of Part 1 (A1,A2,A3,B1,B2) are made concrete by the introduction of the two concepts of Standard Viewpoints and Base Technologies.

The standard viewpoints are:

- Performance
- Safety
- Compatibility
- Operability
- Reliability
- Maintainability
- Environment
- Description
- Qualification

The Base Technologies may change over time. BTs being considered at the present are:

- Information
- Material/Products
- Product/Production
- Tool/Device
- Instrumentation/Control
- Computer and Communication
- Human Interface



It is also necessary to have a means of representing and codifying the results of applying and interpreting the procedures. To this end, five sets of matrices are defined in sections 3.2 to 3.6, corresponding to each procedure. A unique name is also defined for each cell of each matrix to allow labelling of standards areas identified. Section 4 shows how the matrices are used to identify and label standards areas.

Annex A is a list of identified on-going standards-making activities which uses the concepts of Base Technologies, Viewpoints and the labels of the matrices. Areas identified in Section 4, but not covered in Annex A indicate potential areas for new work items.

3 Guide to using the procedures: structured questions

This chapter provides a guide on how the matrices can be populated with identified areas for standardization, by means of the concept of “structured questions” and some examples. The task of sample matrix population will be performed in chapter 4.

3.1 Structured questions

The A and B type procedures of Chapter 2 can be recast in a generic form of structured question which uses the concepts of actions, subjects, viewpoints and BTs, and for which the process of formulation is itself a process of identification of areas of possible standards requirements. The replacement of the generic concepts shown between braces “{ ... }” by particular concepts leads to specific questions whose answers are specific to the area of interest.

So in the following reformulation,

{viewpoint} can be replaced by any of

Performance, Safety, Compatibility, Operability, Reliability, Maintainability, Environment, Description or Qualification;

{subject} can be replaced by any of

Control Information, Data, Material or Resource;

{action} can be replaced by any of

Transform, Transport, Verify or Store;

{level} can be replaced by any of

Section/Area, Cell, Station or Equipment;

and **{BT}** can be replaced by any of

Information, Material/Products, Product/Production, Tool/Device, Instrumentation/Control, Computer and Communication or Human Interface.

The five procedures then become five structured questions, which have the general form of “Are there or should there be **{viewpoint}** standards for significant interactions between **XYZ**, realised in **{BT}** **technology**”, where XYZ represents an “inner question” which depends on the particular procedure. So the specific forms are:

SQ-A1: Are there or should there be **{viewpoint}** standards for significant interactions between **{subject}** and **{action}** at the **{level}** level, realised in **{BT}** technology?

SQ-A2: Are there or should there be **{viewpoint}** standards for significant interactions between **{subject}** and **{subject}** at the **{level}** level, realised in **{BT}** technology?

SQ-A3: Are there or should there be **{viewpoint}** standards for significant interactions between **{action}** and **{action}** at the **{level}** level, realised in **{BT}** technology?

SQ-B1: Are there or should there be **{viewpoint}** standards for significant interactions between **{subject}** of Shop Floor Production and its manufacturing context, realised in **{BT}** technology?

SQ-B2: Are there or should there be **{viewpoint}** standards for significant interactions between **{subject}** at **{level}** and **{subject}** at the levels above or below, realised in **{BT}** technology?

As described in Part 1, the procedures can be represented in matrix form (as shown in Part 1’s Figure 6). With this reformulation, the concepts **{subject}**, **{action}**, **{level}**, **{viewpoint}** and **{BT}** can be used to label each axis (dimension) as appropriate. Because the inclusion of viewpoint and BTs results in about a hundredfold increase in the size of the matrices, they will be omitted in the following general discussion on populating the matrices, although their use may well be justified and necessary in particular circumstances. In particular, they will need to be reintroduced when considering the correspondence between the identified needs for standards and areas where actual standards exist or are being developed.

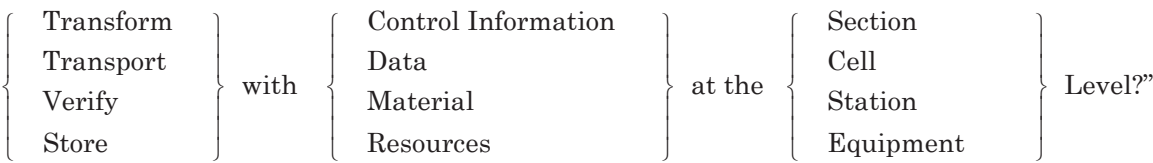
It is also necessary to distinguish between the problems of identifying an area where standards may be required (the objective of the Reference Model) and that of giving a name to such an area. Such a name needs to distinguish the area from others where necessary, but also to associate it with other areas where they should sensibly be aggregated (consolidated) into a larger standards area which applies across several levels, subjects, actions or viewpoints etc. Examples might be requirements for documentation of software, or a concern for traceability. The Reference Model does not itself help with these processes of naming or aggregation (consolidation). However the use of the concepts to label dimensions allows artificial names to be constructed for individual standards areas in the form of matrix co-ordinates.

For completeness, the following section elaborates the questions for each procedure (structured question).

3.2 Procedure A1: Subject-Action interrelationships

In procedure A1 one is concerned with an individual Generic Activity Model (GAM) at a given level of the Shop Floor Production Model (SFPM), and tries to identify areas for standardization which may suggest themselves when contemplating the interrelation between subjects and actions within the GAM at the given level.

When each concept of SQ-A1 is elaborated, this becomes “should there be or are there already standards to relate:



Clause 4.1 gives some possible interpretations for this structured question.
The corresponding matrices for levels 1 to 4 are given in Figure 4. Note that Material is considered only at Level 1.

	CONTROL INFORMATION	DATA	MATERIAL	RESOURCES
TRANSFORM	1.Tf.C	1.Tf.D	1.Tf.M	1.Tf.R
TRANSPORT	1.Tp.C	1.Tp.D	1.Tp.M	1.Tp.R
VERIFY	1.V.C	1.V.D	1.V.M	1.V.R
STORE	1.S.C	1.S.D	1.S.M	1.S.R

PROCEDURE A1 at level 1, Equipment

	CONTROL INFORMATION	DATA	RESOURCES
TRANSFORM	2.Tf.C	2.Tf.D	2.Tf.R
TRANSPORT	2.Tp.C	2.Tp.D	2.Tp.R
VERIFY	2.V.C	2.V.D	2.V.R
STORE	2.S.C	2.S.D	2.S.R

PROCEDURE A1 at level 2, Station

	CONTROL INFORMATION	DATA	RESOURCES
TRANSFORM	3.Tf.C	3.Tf.D	3.Tf.R
TRANSPORT	3.Tp.C	3.Tp.D	3.Tp.R
VERIFY	3.V.C	3.V.D	3.V.R
STORE	3.S.C	3.S.D	3.S.R

PROCEDURE A1 at level 3, Cell

	CONTROL INFORMATION	DATA	RESOURCES
TRANSFORM	4.Tf.C	4.Tf.D	4.Tf.R
TRANSPORT	4.Tp.C	4.Tp.D	4.Tp.R
VERIFY	4.V.C	4.V.D	4.V.R
STORE	4.S.C	4.S.D	4.S.R

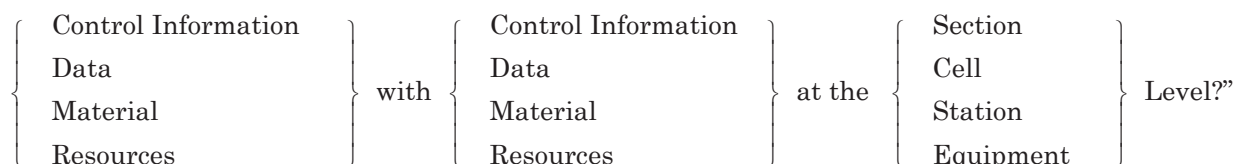
PROCEDURE A1 at level 4, Section/Area

Figure 4 — Matrices for Procedure A1: Subject-Action Interrelationships

3.3 Procedure A2: Subject-Subject interrelationships

For procedure A2 one again considers an individual GAM at a particular level of the SFPM, but this time considering the interrelation between the subjects of control information, material (at level 1 only), resources and data.

When each concept of SQ-A2 is elaborated, this becomes “should there be or are there already standards to relate:



Clause 4.2 gives some possible interpretations for this structured question.

The corresponding matrices for levels 1 to 4 are given in Figure 5. (Material is to be considered only at Level 1.)

	CONTROL INFORMATION	DATA	MATERIAL	RESOURCES
CNTRL. INFO.	1.C.C	1.C.D	1.C.M	1.C.R
DATA	1.D.C	1.D.D	1.D.M	1.D.R
MATERIAL	1.M.C	1.M.D	1.M.M	1.M.R
RESOURCES	1.R.C	1.R.D	1.R.M	1.R.R

PROCEDURE A2 at level 1, Equipment

	CONTROL INFORMATION	DATA	RESOURCES
CNTRL. INFO.	2.C.C	2.C.D	2.C.R
DATA	2.D.C	2.D.D	2.D.R
RESOURCES	2.R.C	2.R.D	2.R.R

PROCEDURE A2 at level 2, Station

	CONTROL INFORMATION	DATA	RESOURCES
CNTRL. INFO.	3.C.C	3.C.D	3.C.R
DATA	3.D.C	3.D.D	3.D.R
RESOURCES	3.R.C	3.R.D	3.R.R

PROCEDURE A2 at level 3, Cell

	CONTROL INFORMATION	DATA	RESOURCES
CNTRL. INFO.	4.C.C	4.C.D	4.C.R
DATA	4.D.C	4.D.D	4.D.R
RESOURCES	4.R.C	4.R.D	4.R.R

PROCEDURE A2 at level 4, Section/Area

Figure 5 — Matrices for Procedure A2: Subject-Subject Interrelationships

3.4 Procedure A3: Action-Action interrelationships

Procedure A3 examines the interrelation of actions within a GAM at a given level of the SFPM.

When each concept of SQ-A3 is elaborated, this becomes “should there be or are there already standards to relate:

$$\left\{ \begin{array}{c} \text{Transform} \\ \text{Transport} \\ \text{Verify} \\ \text{Store} \end{array} \right\} \text{ with } \left\{ \begin{array}{c} \text{Transform} \\ \text{Transport} \\ \text{Verify} \\ \text{Store} \end{array} \right\} \text{ at the } \left\{ \begin{array}{c} \text{Section} \\ \text{Cell} \\ \text{Station} \\ \text{Equipment} \end{array} \right\} \text{ Level?}''$$

Clause 4.3 gives some possible interpretations for this structured question.

The corresponding matrices for levels 1 to 4 are given in Figure 6.

	TRANSFORM	TRANSPORT	VERIFY	STORE
TRANSFORM	1.Tf.Tf	1.Tf.Tp	1.Tf.V	1.Tf.S
TRANSPORT	1.Tp.Tf	1.Tp.Tp	1.Tp.V	1.Tp.S
VERIFY	1.V.Tf	1.V.Tp	1.V.V	1.V.S
STORE	1.S.Tf	1.S.Tp	1.S.V	1.S.S

PROCEDURE A3 at level 1, Equipment

	TRANSFORM	TRANSPORT	VERIFY	STORE
TRANSFORM	2.Tf.Tf	2.Tf.Tp	2.Tf.V	2.Tf.S
TRANSPORT	2.Tp.Tf	2.Tp.Tp	2.Tp.V	2.Tp.S
VERIFY	2.V.Tf	2.V.Tp	2.V.V	2.V.S
STORE	2.S.Tf	2.S.Tp	2.S.V	2.S.S

PROCEDURE A3 at level 2, Station

	TRANSFORM	TRANSPORT	VERIFY	STORE
TRANS FORM	3.Tf.Tf	3.Tf.Tp	3.Tf.V	3.Tf.S
TRANSPORT	3.Tp.Tf	3.Tp.Tp	3.Tp.V	3.Tp.S
VERIFY	3.V.Tf	3.V.Tp	3.V.V	3.V.S
STORE	3.S.Tf	3.S.Tp	3.S.V	3.S.S

PROCEDURE A3 at level 3, Cell

	TRANSFORM	TRANSPORT	VERIFY	STORE
TRANSFORM	4.Tf. Tf	4.Tf. Tp	4.Tf.V	4.Tf.S
TRANSPORT	4.Tp.Tf	4.Tp.Tp	4.Tp.V	4.Tp.S
VERIFY	4.V.Tf	4.V.Tp	4.V.V	4.V.S
STORE	4.S.Tf	4.S.Tp	4.S.V	4.S.S

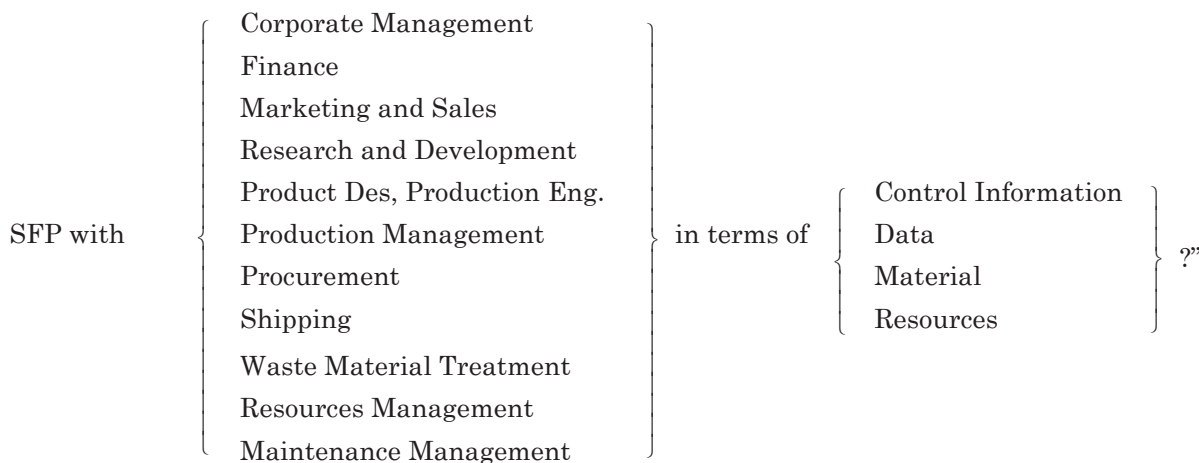
PROCEDURE A3 at level 4, Station/Area

Figure 6 — Matrices for Procedure A3: Action-Action Interrelationships

3.5 Procedure B1: Horizontal (contextual) interrelationships

This procedure attempts to identify areas requiring standardization by considering the interface of the eleven context functions with the shop floor production in terms of subjects.

When each concept of SQ-B1 is elaborated, this becomes “should there be or are there already standards to relate:



Clause 4.4 gives some possible interpretations for this structured question.

The matrix of Figure 7 gives a framework to represent the activities of shop floor production. It appears from Figure 2 of Part 1 that most of corporate management's, finance's, marketing and sales', and research and development's interrelation with the shop floor production are predominantly established via product design, production engineering and production management. Remaining interrelations can at this time be governed only by guidelines, rather than standards.

	CONTROL INFORMATION	DATA	MATERIAL	RESOURCES
F1. CORPORATE MANAGEMENT	F1.C	F1.D	F1.M	F1.R
F2. FINANCE	F2.C	F2.D	F2.M	F2.R
F3. MARKETING & SALES	F3.C	F3.D	F3.M	F3.R
F4. R & D	F4.C	F4.D	F4.M	F4.R
F5. PRODUCT DESIGN/PRODUCTION ENG.	F5.C	F5.D*	F5.M	F5.R
F6. PRODUCTION MANAGEMENT	F6.C*	F6.D	F6.M	F6.R
F7. PROCUREMENT	F7.C	F7.D	F7.M*	F7.R
F8. SHIPPING	F8.C	F8.D*	F8.M*	F8.R
F9. WASTE MATERIAL TREATMENT	F9.C	F9.D	F9.M*	F9.R
F10. RESOURCE MANAGEMENT	F10.C	F10.D	F10.M	F10.R*
F11. MAINTENANCE MANAGEMENT	F11.C*	F11.D	F11.M	F11.R

PROCEDURE B1

Figure 7 — Matrix for Procedure B1: Horizontal (Contextual) Interrelationships

(The cells marked with asterisks were identified in Figure 2 of Part 1, in “Typical Arrangements of Manufacturing Functions”).

3.6 Procedure B2: Vertical interrelationships

Procedure B2 is similar to procedure A2, except that it deals with the interrelation of subjects between a GAM on one level and a GAM on levels above or below, and the interrelation is in practice limited to transport of subjects.

When each concept of SQ-B2 is elaborated, this becomes “should there be or are there already standards to relate:

$$\left\{ \begin{array}{l} \text{Control Information} \\ \text{Data} \\ \text{Resources} \end{array} \right\} \text{ transported across the } \left\{ \begin{array}{l} \text{Section/Cell} \\ \text{Cell/Station} \\ \text{Station/Equip} \end{array} \right\} \text{ Levels?}''$$

Clause 4.5 gives some possible interpretations for this structured question.

If a transport relationship is identified between shop floor production and the eleven other major discrete part manufacturing functions in terms of subjects, then this relationship should be examined for level-specific standards requirements.

The corresponding matrix is given in Figure 8 for the typical example of interrelations between adjacent levels. Any interrelations between non-adjacent levels can be similarly represented and labelled.

		CONTROL INFORMATION	DATA	RESOURCE
SECTION	4/3	4/3.C	4/3.D	4/3.R
CELL	3/2	3/2.C	3/2.D	3/2.R
STATION	2/1	2/1.C	2/1.D	2/1.R
EQUIPMENT				

PROCEDURE B2

Figure 8 — Matrix for Procedure B2: Vertical Interrelationships for adjacent levels

4 Identification of areas for standardization

The following tables show some example areas of identified standards requirements without reference to viewpoints or base technologies. Viewpoints and base technologies relating to existing standards-making are illustrated in Annex A. Annex B gives the same information, but ordered by the Procedure, Level and Cell identifiers.

In the tables, the entry “x” means no standards area was identified, “Ø” means there is no logical interpretation for the cell and “<<” means the entry is the same as that on the left.

4.1 Procedure A1: Subject-Action interrelationships

There are two interpretations for the subject-action interrelation, corresponding to the two possible directions of actions and subjects; that is actions on subjects, or subjects required for actions.

So one interpretation is the action operating on the subject, as in say the transform of material. A standard on the material transformation at level 1 corresponds to standard procedures for processing. Standards on the transportation of data at levels 2,3 and 4 correspond to standard protocols for data transmission, for example OSI standards.

The other interpretation is an interrelation between actions and subjects which are necessary for actions or used in actions. Standards on resources for transformation at level 1 correspond to standards for machine tools, assembling machines, etc. Standards on control information for transformation at level 2 corresponds to standards for numerical control commands, robots control commands, etc.