TECHNICAL REPORT

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Industrial automation — Shop floor production —

Part 1:
Reference model for standardization and a methodology for identification of requirements

Automation industrielle — Production en atelier —

Partie 1: Modèle de référence pour la normalisation et une méthodologie en vue de l'identification des prescriptions

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of ISO technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 10314-1, which is a Technical Report of type 3, was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration.*

This document is being published in the form of a Technical Report because it is not possible, in view of the current state of the art of modelling for manufacturing, to draw up an International Standard which would be complete and precise, and which would not be too restrictive in this rapidly changing field. This Technical Report is intended as a guideline and will be reviewed and augmented periodically.

ISO/TR 10314 consists of the following parts, under the general title *Industrial automation — Shop floor production*:

— *Part 1: Reference model for standardization and a methodology for identification of requirements*

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

Introduction

This report is intended to provide a tool to help identify and co-ordinate present and future activities involving ISO and IEC standards work in the field of industrial automation. Specifically, the Reference Model developed within the technical report is to be applied to the area of Discrete Parts Manufacturing. For the purposes of this report the word "manufacturing" should hereafter be interpreted to mean Discrete Parts Manufacturing. While the Reference Model may have application beyond the area of Discrete Parts Manufacturing, the developers of the Reference Model have not tested the Reference Model in other areas of industrial automation activities.

Since the model and the methodology will need to be refined so as to adjust to emerging technologies, a technical report rather than an international standard has been chosen as the means of presentation.

This technical report does not include the development of individual standards themselves, but rather the establishment of a common framework, in terms of a Reference Model, to assist future standards development.

The Reference Model for standardisation must be:

- simply structured, flexible, modular and generic,
- based upon readily available and acceptable terminology,
- able to be applied to a wide range of manufacturing operations and organisations, recognising the need to interface equipment and systems to human beings,
- independent of any given, predetermined realisations in terms of system configurations or implementations,

- open-ended in its ability to be extended, and in its ability to encompass new technologies without unreasonably invalidating current realisations

- independent of existing technologies in manufacturing automation and computer science.

This Reference Model and its methodology are to be used to identify areas for standardisation and will benefit organisations involved in developing such manufacturing standards. It will also be of interest to the manufacturing community consisting of both suppliers and users, but it is not intended to be a design for system integration of manufacturing.

The report for the Reference Model for Shop Floor Production Standards is comprised of two parts. Part 1 describes the Reference Model and methodology for identification of possible standards requirements. It addresses the following issues:

a) a review of existing models and modelling methodologies,

b) the derivation of an initial, generic, standards classification scheme for manufacturing,

c) the adoption of a functional view of a manufacturing enterprise,

d) the establishment of an initial reference model according to the results of a) - c),

e) the development of a methodology for extracting areas of standards.

Part 2 describes the application of this Reference Model and methodology for extracting areas of standards. It addresses:

i) the application of the methodology in order to derive a particular list of areas for required standards,

ii) the identification of areas for standards,

iii) the derivation of standards requirements.

The separate development of Part 2 may show that modifications are necessary to the highly interrelated Part 1. Normal ISO procedures will address this issue.

This document is Part 1 and consists of this introduction and seven chapters. In Chapters 1, 2, and 3 respectively, the scope and the field of application, description of terms and abbreviations are described. The objectives of standardisation for manufacturing are described in Chapter 4. Chapter 5 contains the Reference Model. Chapter 6 introduces the methodology for applying the Reference Model to clarify and extract areas of standards and this methodology is further amplified in Part 2. Chapter 7 provides an overall summary of the document.

Industrial automation — Shop floor production —

Part 1:
Reference model for standardization and a methodology for identification of requirements

1 Scope and Field of Application

1.1 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 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.

1.2 Field of Application

The Reference Model described in this report is intended for use in the identification of standards within the Shop Floor Production area of manufacturing.

Manufacturing is perceived to be all inclusive, from customer order through to delivery of the product. Twelve manufacturing functions have been identified as being a part of manufacturing. The following is a list of these twelve functions, together with illustrative, non-exhaustive activities typically related to these functions:

1) Corporate management, e.g.
   - Direction of enterprise
   - Strategic planning
   - Feasibility study for investment
   - Risk management

2) Finance, e.g.
   - Financial planning
   - Corporate budgeting
   - Financial accounting

3) Marketing and sales, e.g.
   - Marketing research
   - Advertising
   - Sales forecasting
   - Sales scheduling
   - Pricing
   - Sales (order, delivery, invoice)
   - Product service

4) Research and Development, e.g.
   - R & D planning
   - Basic research
   - Applied research
   - Product development
   - Manufacturing development

5) Product design and Production engineering, e.g.
   - Define product specifications
   - Preliminary design and testing
   - Detailed design
   - Design analysis, test, evaluation
   - Revise design
   - Release design for production planning
   - Project management
   - Process planning
   - Programming of numerical control and programmable control
   - Tooling
   - Plant engineering
   - Bill of material
   - Quality assurance planning of production
   - Production configuration

6) Production management, e.g.
   - Production scheduling
   - Product and Inventory control
   - Production monitoring
   - General maintenance request
   - Quality control
   - Cost control and cost management

7) Procurement, e.g.
   - Vendor performance
   - Purchasing
   - Receiving
   - General stores

8) Shipping, e.g.
   - Product storage
   - Distribution

9) Waste material treatment, e.g.
   - Waste material processing
   - Waste material storage

10) Resource management, e.g.
- Facility management
- Tool control
- Energy management
- Time and Attendance
- Facility security
- Health and Safety
- Environment control

11) Maintenance management, e.g.
- Preventive maintenance
- Corrective maintenance

12) Shop Floor Production, e.g.
- Material store
- Transport material
- Transform material
- Incoming inspection
- In-process gauging and testing
- In-process audit
- Product audit

As shown in Figure 1 and described in the definitions which follow in Section 2.2, these functions tend to be grouped under three main headings. Items 1) through to 4) are functions of the Enterprise concerned with strategic long term planning activities. Items 5) through to 11) are functions of the Facility, concerned with tactical planning of the production process, resource management and product modelling. The final item, 12) Shop Floor Production, is a function which involves the activities that actually create a physical product.

The twelve manufacturing functions are interrelated and a single Reference Model covering all twelve functions would be desirable. After careful study of existing work, it was decided that the development of a single Reference Model covering every function of manufacturing was not manageable at this time.

The area of Shop Floor Production on the other hand has shown an urgent need for and a willingness to adopt standards. The Reference Model described in this technical report is intended to guide the planning for and the development of standards to assist the integration of an automated Shop Floor Production system. It is recognised that the Shop Floor Production function will be required to interface with

functions (and their activities) outside the scope of Shop Floor Production itself. Figure 2 is a clarification of how major functions of manufacturing might be interrelated.

In the future, Reference Models for manufacturing that include Enterprise and Facility functions may be developed. Any future modelling work in the area of manufacturing should take account of the Reference Model for Shop Floor Production presented here and every effort should be made to ensure compatibility between the Reference Model for Shop Floor Production and any Facility or Enterprise Reference Models that may be developed.

2 Terminology

2.1 General

A number of terms are described in this chapter to provide a better understanding by the user of this report. These descriptions are intended to be used solely in the context of this report and are not intended to be general definitions.

2.2 Specific terms

2.2.1 Reference Model: a means of describing the activities and components of manufacturing through the use of figure(s) and text.

2.2.2 Discrete Parts Manufacturing: systems of functions for producing products or parts consisting of discrete elements.

2.2.3 Function: a grouping of several activities performed to realise some manufacturing objective.

2.2.4 Activity: a manufacturing process which causes some change in inputs.

2.2.5 Level: a collection of activities which form a degree of subordination in a hierarchical arrangement.

2.2.6 Enterprise: an entire manufacturing unit consisting of a corporate component and one or more Facility components. The corporate component is responsible for interactions between the external environment of the Enterprise and the Facility or Facilities, and also for the control of functions within the Facility or Facilities.

2.2.7 Facility: a component of an Enterprise which excludes corporate functions. The Facility is responsible for providing support and direction for Enterprise and Shop Floor Production activities.

2.2.8 Shop Floor Production: a component of a Facility whose function is directly related to the production of discrete parts and/ or products.

2.2.9 Shop Floor Production Model: the basic model used to describe the structure within Shop Floor Production.

2.2.10 Interaction: an interrelationship or interconnection between the Subjects within Shop Floor Production, and also between the Subjects and Actions within or external to Shop Floor Production.

2.2.11 Generic Activity Model: a generic model used to describe the execution of activities within Shop Floor Production and their interactions with functions interfacing to Shop Floor Production.

3 Abbreviations

Several abbreviations are used in this report:

- GAM Generic Activity Model
- SFPM Shop Floor Production Model
- ST Store
- TF Transform
- TP Transport
- VE Verify

4 Objectives for Manufacturing Standardisation

4.1 General information

4.1.1 The objectives of standardisation

ISO has pointed out the objectives of standardisation as follows:

- mutual understanding
- health, safety, protection of environment
- interface, interchangeability
- fitness for purpose
- variety control.

4.1.2 The concept of Standards Viewpoints

The process of standardisation for manufacturing is to define areas of standards, to select aspects to be standardised and to define standards based on the state of the art. In this report, the following Standards Viewpoints (defined in 4.2) have been selected to identify the needs of standards in the manufacturing field derived from the guidance of the above ISO objectives:

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

These nine Standards Viewpoints, together with the Reference Model, are used in the proposed methodology for extracting areas of standards.

4.2 Standards Viewpoints for Manufacturing

Nine Standards Viewpoints for manufacturing are defined as follows and are to be applied to any area where standards may apply:

4.2.1 Safety Viewpoint

Safety is concerned with the effect on safety that normal and erroneous operation of the manufacturing facility would have on the operating personnel, the equipment and the work in progress. It also covers the need for traceability, that is the ability to trace the sequence of manufacturing processes and components used in manufacture. Hence define design and operation standards to ensure safe operation.

4.2.2 Environment Viewpoint

Environment is concerned with the effect that operating entities can have on the physical environment both during the manufacturing activity itself and as a by-product of that activity. In each case both normal and failure modes should be considered. Hence identify standards which define each effect, how it is to be measured and norms for acceptable operation.

4.2.3 Compatibility Viewpoint

Compatibility is concerned with interchangeability and interdependence, and addresses issues related to interfacing. Hence define design and operation standards to ensure compatibility.

4.2.4 Performance Viewpoint

Performance is concerned with the performance aspects which can be categorised in terms of speed, quality of finish (output), resources consumed etc. Hence identify standards to define these qualities and appropriate specifications.

4.2.5 Operability Viewpoint

Operability is concerned with all aspects of human interactions with the manufacturing environment. It is essentially concerned with easy operation and the avoidance of improper operation under both normal and erroneous conditions. Hence define design and operation standards to ensure easy and correct operation.

4.2.6 Maintainability Viewpoint

Maintainability is concerned with reducing downtime and the risks and costs of evolution. It is very important to enable easy maintenance of all manufacturing constituents and the system itself, to maintain a known status for each manufacturing entity and its documentation and to support traceability where required. Hence define design and operation standards to ensure easy maintenance.

4.2.7 Reliability Viewpoint

Reliability is concerned with all aspects of how a system is designed and operated to meet specified levels of availability. This starts with the reliability of individual elements and components, and goes up to the reliability of the entire system and organisation. Hence define design and operation standards to ensure reliability.

4.2.8 Qualifications Viewpoint

Qualifications are concerned with the quality of personnel for achieving the proper design and operation of manufacturing entities. The viewpoint is essentially concerned with the training of operators as qualified experts. Hence define design and operation standards for the qualifications of personnel for managing manufacturing activities.

4.2.9 Description Viewpoint

Description is concerned with all aspects of how the design and operation of manufacturing entities are defined and described to provide all persons concerned with a means of mutual understanding. It is essentially concerned with the terminology, identification and description of documents. Hence define design and operation standards to ensure mutual understanding in the manufacturing field.

5 The Reference Model for Shop Floor Production

5.1 General Information

This chapter describes the Reference Model developed to be used in the identification of standards within Shop Floor Production.

The Reference Model presented in the following three sections is in many ways a synthesis of a variety of existing models. Firstly the major activities undertaken for manufacturing are identified as a context for Shop Floor Production. Secondly a Shop Floor Production Model (SFPM) is presented which groups Shop Floor activities into hierarchical levels. Thirdly a Generic Activity Model (GAM) is presented to model the various activities within each level of the SFPM.

Each activity in Shop Floor Production can be represented by an instance of the GAM. The various elements of the GAM will have different interpretations for any given activity.

The intent of this Reference Model is to assist in identifying where standards may be required and the detail is not sufficient for other purposes such as providing a basis for designing or implementing a manufacturing system. The Reference Model presents a functional view of the Enterprise, Facility and Shop Floor Production.

5.2 The Context of Shop Floor Production

Section 1.2 sets out the scope of manufacturing, identifying 12 major functions. Figure 1 shows one example of how Shop Floor Production takes place in a context established by those other functions. Accordingly interactions occur between many of the activities of Shop Floor Production and those of the Facility, and to a lesser extent with those of the Enterprise itself. The methodology described later allows for these interactions to be identified, in addition to the interactions occurring within Shop Floor Production itself.

5.3 The Shop Floor Production Model (SFPM)

Shop Floor Production is distinguished from the other eleven manufacturing functions identified in Section 1.2 by the fact that it contains those activities which are directly engaged in producing parts. It is common practice to group these activities into several levels.

In this report, a four level model is selected to present the activities of the Shop Floor Production function. 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.

Also this report identifies four types of manufacturing activity, each type corresponding to each level of Shop Floor Production. There can be (and generally are) several activities in progress at the same time at each level. The types of activity are:

1) execute shop floor production processes
2) command shop floor production processes
3) co-ordinate shop floor production processes
4) supervise shop floor production processes.

The four level model in Figure 3 illustrates the structure of Shop Floor Production. This model is called the Shop Floor Production Model (SFPM). The figure shows the name of each level and the corresponding type of activities at this level together with its description.

5.4 The Generic Activity Model (GAM)

This technical report approaches the modelling of those characteristics relevant to standards identification within the SFPM through the concept of an activity. A Generic Activity Model (GAM) as shown in Figure 4 has been developed to model the execution of the various activities at each level.

The internals of the GAM represent an interrelated set of four Subjects and four Actions. The Subjects and Actions are defined below:

5.4.1 Four Subjects

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; basic resources such as supply material, energy, space and time; personnel.

Note: The general class of "**information**" is defined here to consist of control information and data, that is as the union of a) and b) above.

5.4.2 Four Actions

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 or Facility until they are required to be transported.

The GAM describes the execution of activities in terms of four Subjects (Control Information, Data, Material, Resources) and four Actions (Transform, Transport, Verify, Store). The GAM is developed from a view that the realisation of manufacturing activities can be represented in terms of these four Subjects and four Actions.

The representation of a given activity will be a specific instance (an instantiation) of the GAM in which specific correspondences (bindings) are established between the elements of the GAM (Subjects, Actions) and the entities which correspond to those elements for that particular manufacturing activity.

Not all elements of the GAM will be present in every instance - the lowest level of Shop Floor Production for example does not have command and status information for the non-existent level below.

Major manufacturing activities may be decomposed into (sub)activities in a horizontal fashion (into a series of further activities) or in a vertical/ hierarchical fashion (into levels of activities). The GAM is generic in the sense that it can be applied to all activities.

Establishing specific GAM bindings to particular manufacturing activities yields specific Subjects and Actions. The A- and B-type procedures described in Section 6 can then make use of these specific Subjects and Actions in identifying areas of standards.

6 Methodology for extracting areas of standards

6.1 General Information

There are a number of interactions among activities, and among Subjects and Actions within activities, which are used to identify the area of standardisation in manufacturing. Therefore the methodology consists of examining the various activities, Subjects and Actions in various relationships and connections to determine if a standards requirement is defined.

The goal of standardisation is to permit more effective relationships and connections between two or more objects. In manufacturing, objects may be machine-to-machine relationships and/ or connections, or man-to-machine relationships and/ or interactions.

The Reference Model described in the preceding chapter is essentially declarative rather than procedural — that is it presents a set of concepts and a hierarchical approach by which a manufacturing Enterprise can be better understood. The Model defines useful manufacturing functions, characteristics and relationships amongst them. It is also necessary to show how they can be used to identify standards areas for manufacturing.

This chapter provides such a methodology for extracting areas of standards.

6.2 Overall approach

The way in which the various elements of the Reference Model are used to identify standards is illustrated in Figure 5. The various activities of manufacturing are grouped into twelve major functions. One of these, Shop Floor Production, is further modelled by a four level model, SFPM (Figure 3).

The various activities at each level of SFPM can each be modelled by the GAM (Figure 4), with each such instantiated model resulting in bindings for GAM concepts (Subjects, Actions). The activities of SFPM can be combined into vertical and horizontal arrangements and this fact is recognised in the procedures of 6.3 which identify potential areas for standards, each of which can be represented by a cell entry in the matrices of Figure 6.

Once a potential standards area has been identified (a non-empty cell entry) it should be examined in the light of

- the technologies of interest, i.e. the technologies that might be evident in the Subjects and Actions for that area, and
- the Standards Viewpoints described in Section 4.2.

These two concerns act as filters which restrict areas of standards to those which are realisable with current technology and which reflect the objectives of standardisation.

6.3 Extraction Procedures

These procedures use the concepts of the Reference Model and describe how these can be examined to identify potential areas for standards. The approach places strong emphasis on interactions between elements of a system. Consequently it is expected to produce areas of potential standards which are prerequisites for systems integration.

The various combinations in the Reference Model alluded to above are examined by applying the two kinds of procedures defined below to each of the Standards Viewpoints.

It is important to note that:

- each of the two kinds of procedure can be applied independently of one another,
- the same standard might arise from applying different procedures and
- the application of these procedures is not guaranteed to produce an exhaustive list of standards but rather to clarify areas of standards.

6.3.1 Procedures A: the "Interrelationship within a level" procedures

These procedures are used for extracting areas of standards for interrelationship between Subject and Action, Subject and Subject, and Action and Action corresponding to each level of the SFPM.

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.

6.3.2 Procedures B: the "External" procedures

These procedures are used for extracting areas of standards for interrelationship between activities for both vertical and horizontal structure.

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

Procedure B1: **Horizontal** interrelationship

For each level of the SFPM consider any possible interrelationships between Shop Floor Production and other manufacturing functions (the context functions 1..11 of 1.2) for applicable areas of standards.

Procedure B2: **Vertical** interrelationship

For each level of the SFPM consider any possible Subject interrelationship with the level above and below for applicable areas of standards, and hence relevant Subject attributes.

6.4 Matrix Representation of Identification Procedures

Corresponding to each procedure (A1, A2, A3, B1, B2) it is possible to envisage a matrix which represents that procedure graphically. These are shown schematically in Figure 6. Each cell of each matrix represents a potential area for standards. Similar matrices are used in Part 2 of this report to show the standards areas identified through the application of these procedures, as well as worksheets for other users of the Reference Model and its methodology.

7 Summary

This document is Part 1 of a report on a means to identify where industrial automation standards for Shop Floor Production may be required. It has described a Reference Model which may be used as a systematic method for determining areas for standards development work. Part 2 of the report describes an application of the methodology which utilises this Reference Model in identifying these areas, catalogues them and cross-references them with standards already completed or in the process of development.

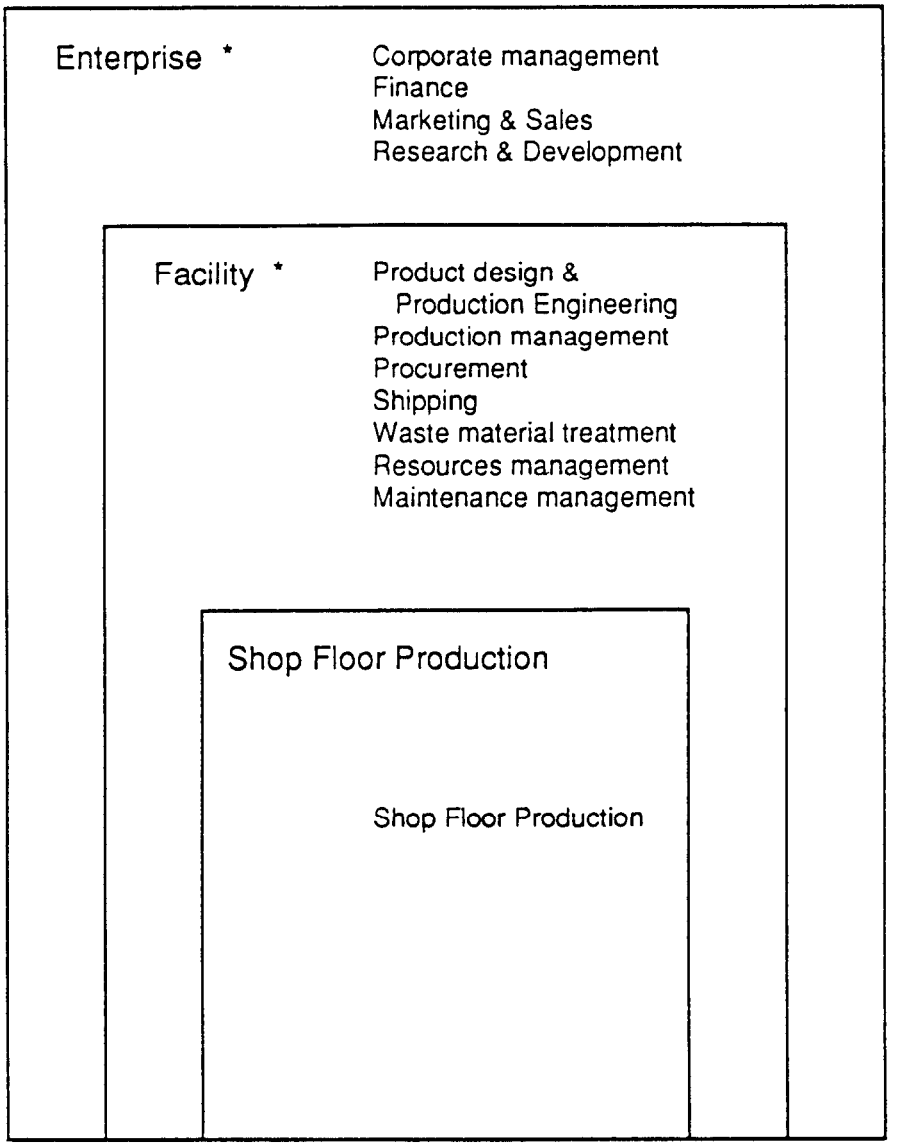


Figure 1 - Typical Grouping of Manufacturing

* The combination of Enterprise and Facility form the context of Shop Floor Production as described in 5.2.

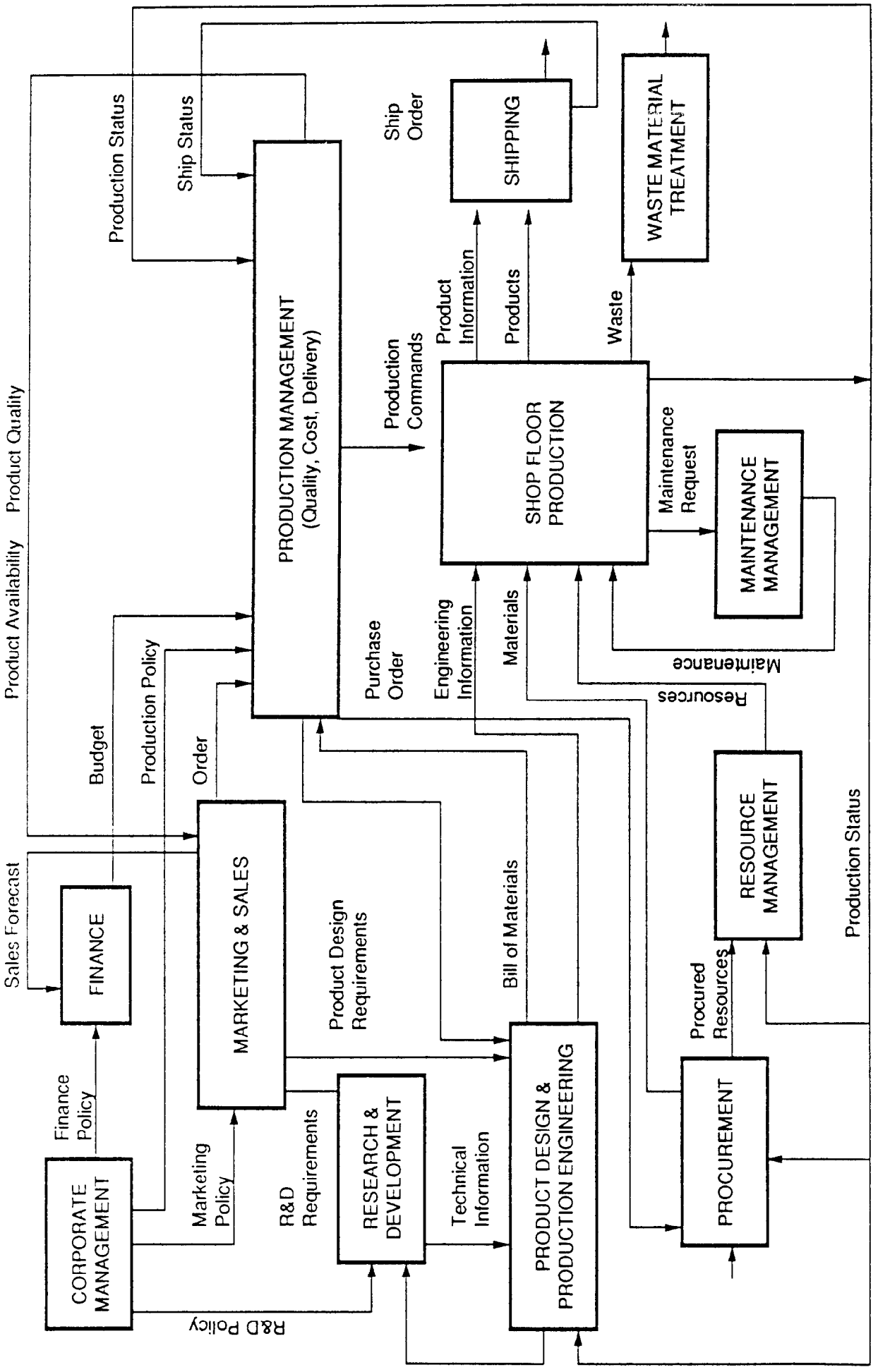
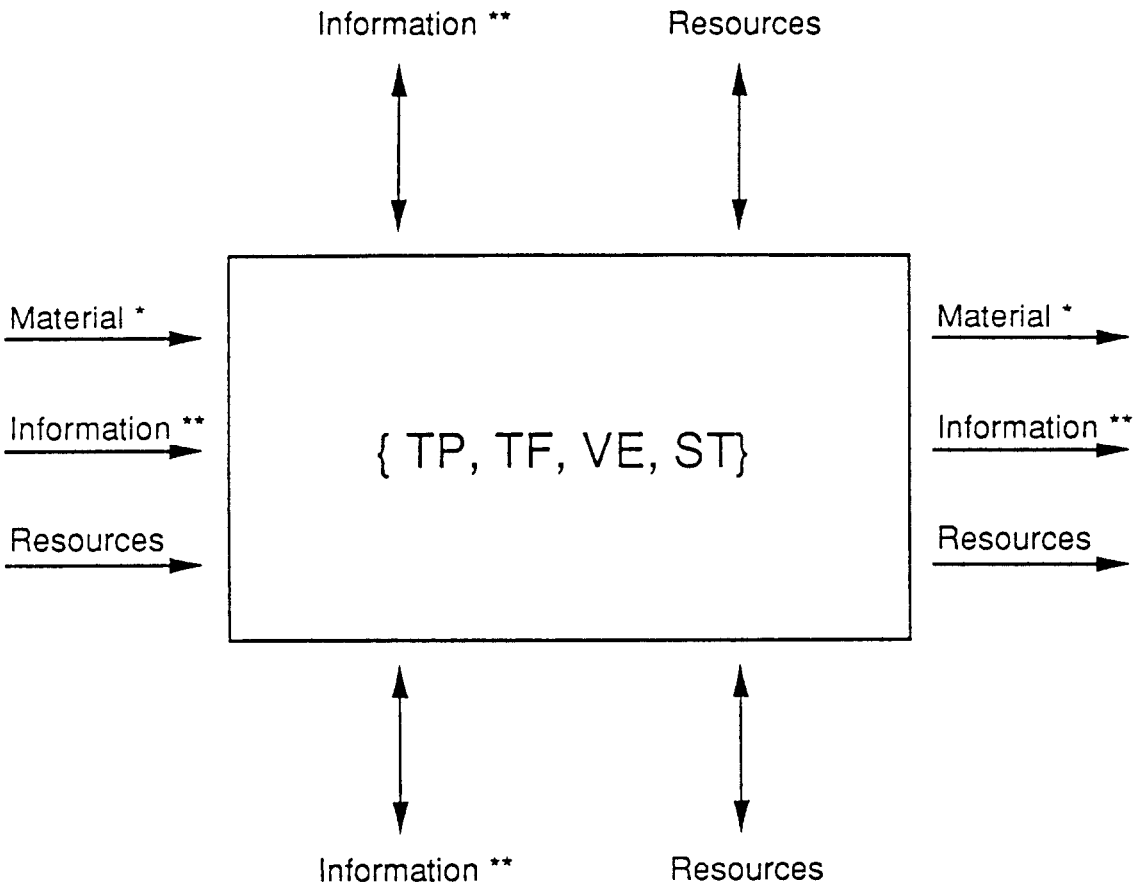


Figure 2 - Typical Arrangements of Manufacturing Functions

	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 3 - Shop floor production model (SFPM)



* Actions {TP, TF, VE, ST} on Material are defined only at Level 1

TP = Transport
TF = Transform
VE = Verify
ST = Store

** Information is defined in the text to include both control and data components. For strict hierarchies, horizontal Information flows are restricted to data components

Figure 4 - Generic Activity Model

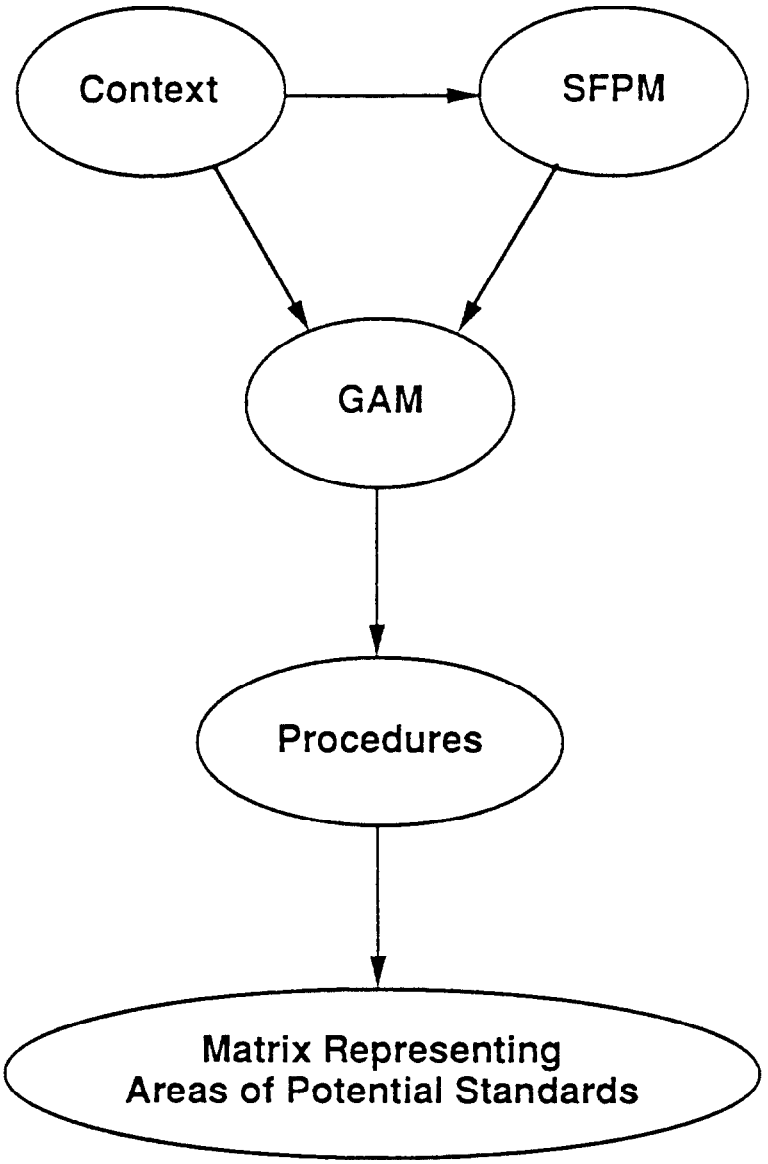


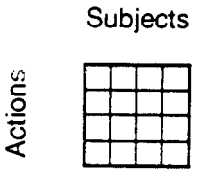
Figure 5 - Overall Approach to identifying areas of standards

NOTE: Part 2 will also use concepts of appropriate technologies and Standards Viewpoints to restrict potential areas for standards into those which are practical and desirable.

A1 : Subject - Action

For each level,

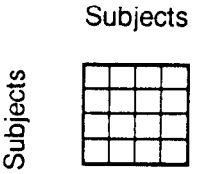
consider —



A2 : Subject - Subject

For each level,

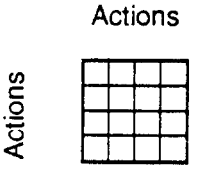
consider —



A3 : Action - Action

For each level,

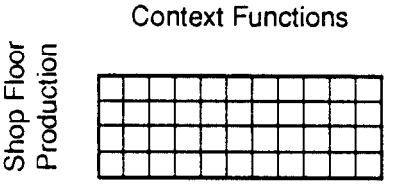
consider —



B1 : Horizontal

For each level,

consider —



B2 : Vertical

For each level,

consider —

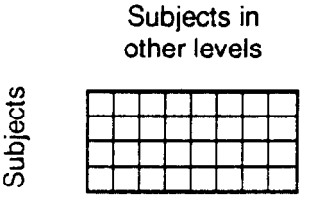


Figure 6 - Matrix representation of identification procedures

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Descriptors: manufacturing, automation, standardization, standards, models.

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