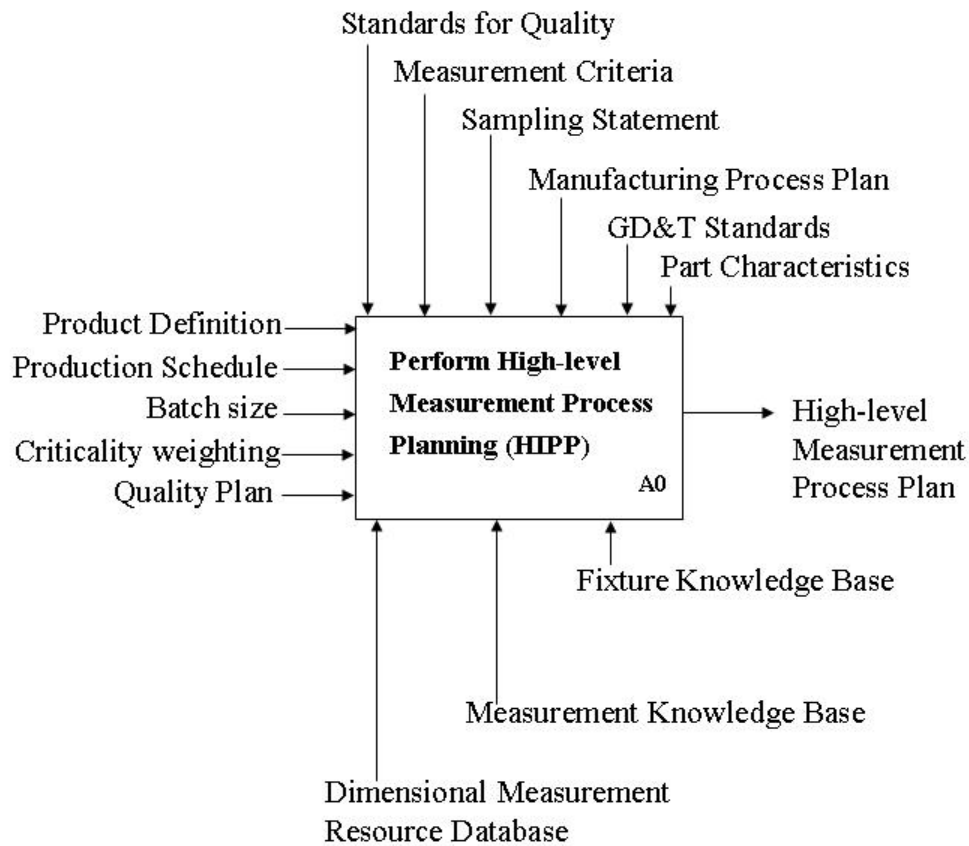


HiPP Activity Model

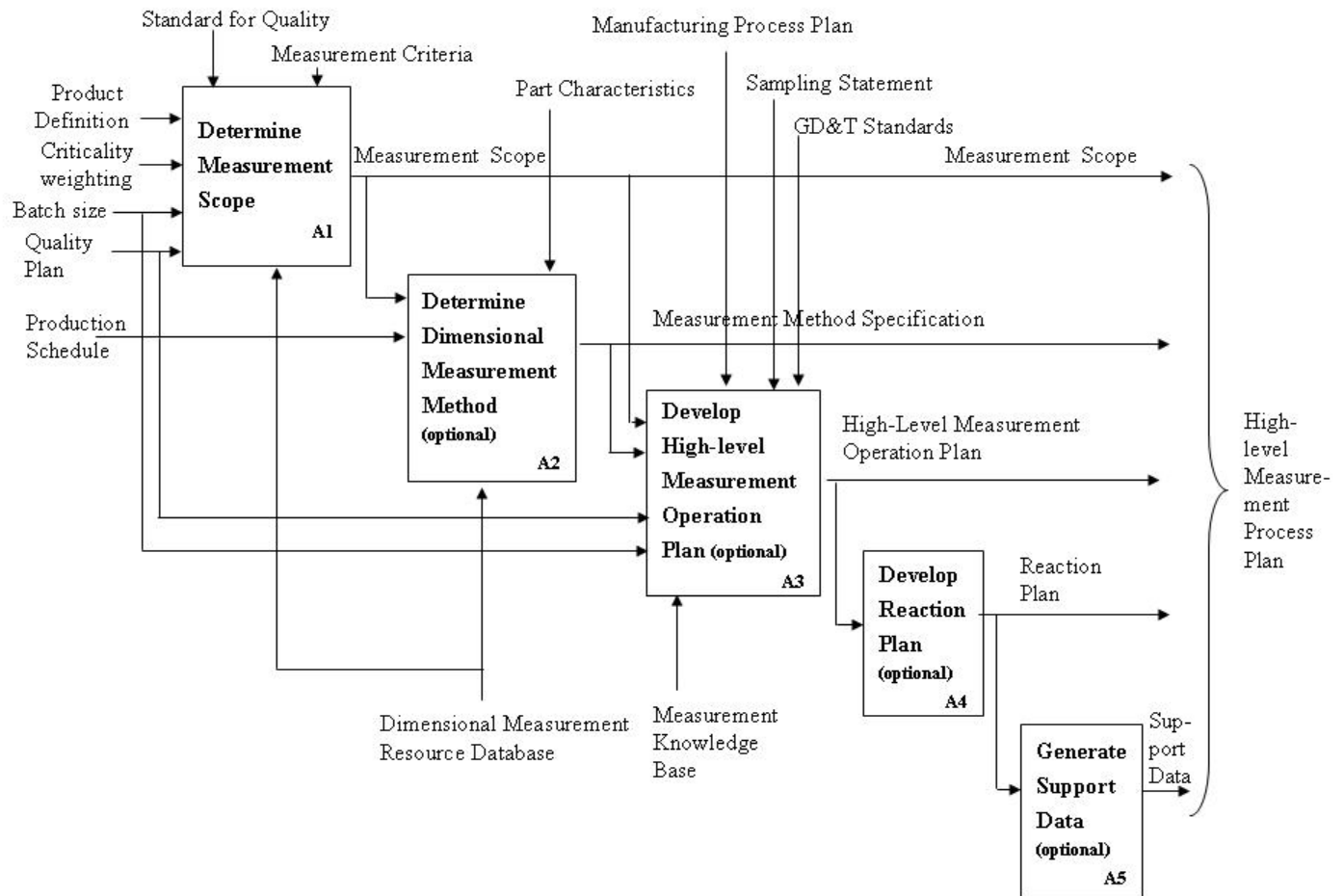
Shaw C. Feng
NIST

Joint DMSC and the 53rd ISO/TC184/SC4 meeting
Irving, TX
October 31, 2007

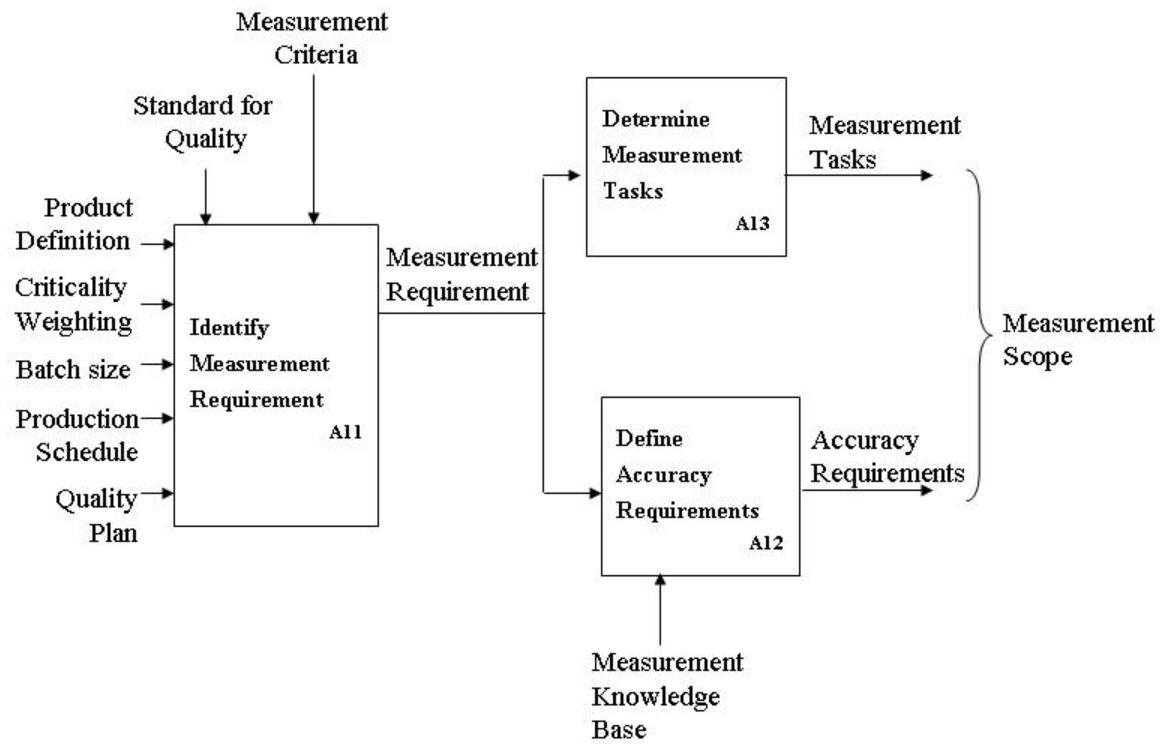
Measurement Requirements



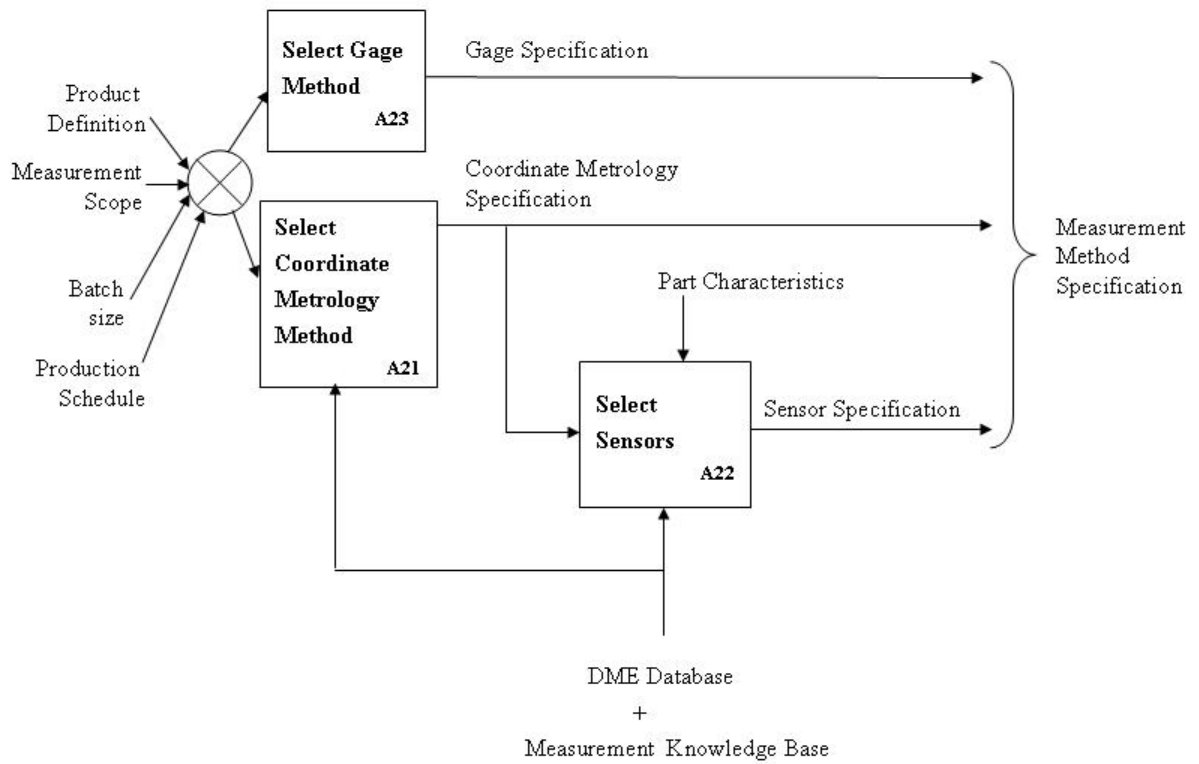
High-level Measurement Process Planning



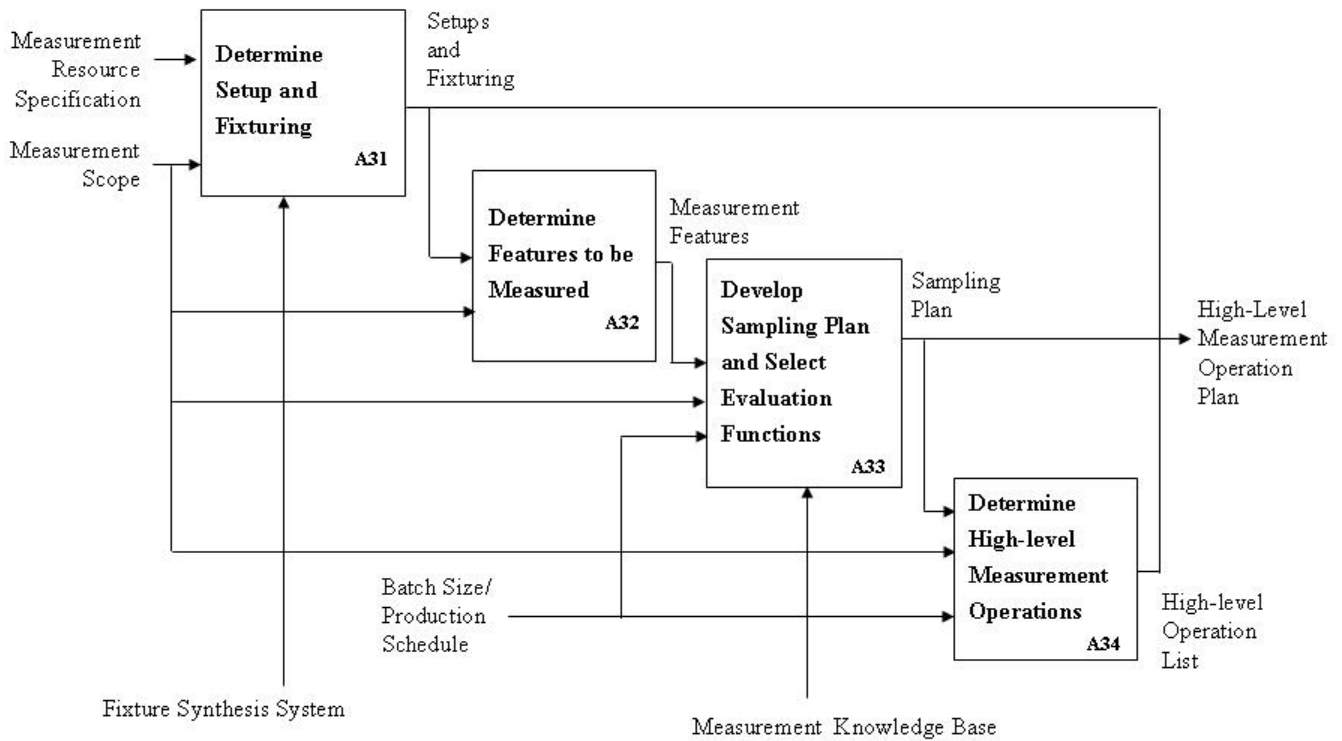
Determining Measurement Scope



Determining Measurement Method



Determining High-Level Measurement Operation Plan



High-level Measurement Process Planning Glossary

Activity

A0 Perform High-level Measurement Process Planning (HiPP)

A0 is the overall activity to develop a high-level measurement process plan that defines measurement scope, optionally dimensional measure equipment list, optionally a sequence of high-level measurement operations, optionally a reaction plan, and optionally supporting data. The input data to A0 includes product definition, production schedule, batch size, criticality weighting, and quality plan. A0 has a supporting dimensional measurement resource database and measurement knowledge base for decision making, as well as fixture knowledge base for high-level dimensional measurement process planning. A0 has the control data of standards for quality, measurement criteria, sampling statement, manufacturing process plans, GD&T standards, and part characteristics. The output from A0 includes a high-level measurement process plan. A high-level measurement process plan has different layers of information. The core defines measurement requirements. The first layer outside the core is a list of selected dimensional measurement equipment used to perform A0. The second layer is a sequence of high-level measurement operations. The third layer is a reaction plan and support data. A0 can be decomposed into five subactivities.

A1 Determine Measurement Scope

A1 is a decomposition of A0. It is an activity is to define the scope for High-level Measurement Process Planning. A1 is further decomposed into three subactivities A11, A12 and A13.

A11 Identify Measurement Requirements

A11 is a decomposition of A1. It is to identify the measurement requirements defined by the stakeholder's quality plan. This subactivity typically identifies the tolerances and/or parameters to be verified while incorporating the accuracy requirements, production schedules, and sampling strategies into the requirements.

A12 Define Accuracy Requirements

A12 is a decomposition of A1. Based on the product acceptance criteria, A12 is to specify magnitudes of pass error and fail error on evaluating measurement features against their tolerance or dimension specifications.

A13 Define Measurement Task

A13 is a decomposition of A1. It decomposes the measurement requirements into specific measurands to verify tolerances/parameters or establish datum features. It also determines the measurement tasks that are to be performed to evaluate each measurement requirement. This activity requires sufficient product data, which should include geometric and topological information of a geometric model with associated tolerances, dimensions, and datum references.

A2 Determine Dimensional Measurement Method

A2 is a decomposition of A0. It is an activity to determine all the measurement methods necessary measuring methods to perform measurement scope. Since it is on Layer One, A2 is optional. It can be decomposed into three subactivities.

A21 Select Coordinate Metrology Method

A21 is a decomposition of A2. It is to select types/classes of coordinate metrology to perform the measurement.

A22 Select Sensors

A22 is a decomposition of A2. It is to select types/classes of sensors that will be used with the selected coordinate metrology types/classes to perform the measurement .

A23 Select Gage Method

A23 is a decomposition of A2. It is to select types/classes of gages method to perform the measurement.

A3 Develop High-level Measurement Operation Plan

A3 is a decomposition of A0. It is to develop a sequence of measurement operations. An operation is to perform an measurement task on a specific measurement feature in a specific setup with identified dimensional measurement equipment and predefined sample plan. A3 can be decomposed into four subactivities.

A31 Determine Setup and Fixturing

A31 is a decomposition of A3. It is to determine part setups on a measurement machine with proper fixturing to enable measurement operation to be performed.

A32 Identified Features to be Measured

A32 is a decomposition of A3. Based on the measurement requirements, A32 is to identify surface areas to be measured. An identified surface area to be measured can also be referred to as an measurement feature. A measured surface area is used to verify a tolerance or a dimension or to establish a datum.

A33 Develop Sampling Plan and Select Evaluation Functions

A33 is a decomposition of A3. It is to develop a sampling plan for measuring all the identified measurement features and/or for selecting frequency of part to be measured in a batch, and select mathematical functions to evaluate sampled points.

A34 Determine High-Level Measurement Operations

A34 is a decomposition of A3. It is to determine a sequence of operations based on measurement features, setups, and selected DME. Also, sampling strategy for a measurement feature will be described, as specified in the sampling plan developed in A33.

A4 Develop Reaction Plan

A4 is a decomposition of A0. It is to develop a plan to react on possible measurement results.

A5 Generate Support Data

A5 is a decomposition of A0. It is to generate necessary support data for a high-level measurement plan. Support data include, for example, due date, labor skill requirements, work order, and equipment order.

Input, output, mechanism/resource, and control data

Accuracy Requirements:

Requirement on magnitudes of pass error and fail error on all the inspected parts.

Batch size:

The quantity of parts in a batch of a job.

Coordinate Metrology Specification

Specific and/or classes of coordinate metrology that are needed to perform measurement.

Criticality Weighting:

The criticality level of an element of the measured part.

Dimensional Measurement Resource Database:

A database that contains information on measurement resources, such as coordination measuring machines, fixtures, rotary tables, sensors, and gages.

Fixture Knowledge Base:

Then knowledge base in a computer software system used to assist a measurement planner to generate setups and specify part fixturing methods with clamping devices.

Gage Specification:

Specific and/or classes of gages that are needed to perform measurement.

GD&T Standards:

National and international standards on dimensioning and geometric and statistical tolerancing.

High-Level Measurement Operation Plan:

A document that specifies a sequence of measurement features to be inspected, the setup sequence, a list of selected DME, and measurement requirements.

High-level Measurement Process Plan:

A document of high-level instructions to inspect parts. High-level instructions should include measurement requirements, with or without the selection of dimension measurement equipment, high-level measurement operations, a reaction plan, and support data.

Manufacturing Process Plan:

A set of instructions on sequence(s) of operations, tool selections, setup, and process parameters selection for a product manufacturing.

Measurement Criteria:

Company's rules and regulations on measurement for measurement verification and/or product acceptance.

Measurement Features:

A surface area or a set of connected surface areas that will be in contact with a gage or sensed by a sensor in a measurement operation.

Measurement Knowledge Base:

A database that contains knowledge for determining how parts should be inspected.

Measurement Method Specification:

A specification of measurement methods that will be used to fulfill the requirements in measuring a part.

Measurement Requirements:

Required instructions for inspecting manufactured parts. Required instructions include tolerances and dimensions to be verified and acceptable pass/fail errors.

Measurement Scope:

The specific tolerances and dimensions on a manufactured part that need to be verified by a measurement.

Measurement Tasks

This is the specific measure task that must be performed to accommodate the measurement requirements. The measurement task corresponds with a measurand, which associates a `dme_measure_feature` with a one or more tolerances or one or more datum reference frames. A measurement task can be a Generate Measure Task, Evaluate Tolerance Measure Task, or Establish Datum Feature Measure Task. Typical tasks might be to measure a `0.12_hole_feature` for general criteria (all corresponding tolerances and optional datum features), to measure the `3.5_hole_feature` to evaluate its `size_+/-0.20_tolerance`, or to measure the `bottom_planar_feature` to establish the primary datum labels A for datum reference frame DRF_AB&C.

Part Characteristics:

Special attributes of a part that affect measurement process planning, such as sensor selection. Part characteristics include the material type of the part and surface characteristics. Surface characteristics include the reflectiveness and roughness of the surface of that is to be measured.

Product Definition:

All the necessary information on a product design for manufacturing and measurement planning. The information has, but not limited to, geometry, topology, measurement feature, tolerance, dimension, datum reference, material, and surface characteristic.

Production Schedule:

Schedule of the production of a product, including measurement schedules.

Reaction Plan:

A document of reaction to possible measurement results.

Quality Plan

A plan defining the quality requirements for a specific product.

Sampling Plan:

A document that specifies point locations and densities for measuring all the measurement features. On the part level, a sampling plan describes the frequency of measuring manufactured parts or the quantity of parts to be measured in a batch.

Sampling Statement:

A qualitative statement on sampling rate and sampling size.

Sensor Specification:

Specific and/or classes of sensors that are needed to perform measurement.

Setups and Fixturing

A specification of setups needed to inspect all the tolerances and dimensions within the measurement scope and all the clamping devices that are needed in all the setups.

Standards for Quality:

International standards on quality assurance, such as standards of the ISO 9000 series.

Support Data:

Measurement supporting information, such as job starting date, due date, work order, labor skill requirements, and equipment orders.

Acknowledgement

Members of the HiPP community have provided many excellent suggestions and comments to the development of this activity model.