Towards a Full Work Break down structure for MICE
Paul Drumm, 2nd July 2003
Version 3

Introduction

The International Peer Review chaired by Alan Astbury recommended that MICE should develop a full work breakdown structure (or equivalent) "at least to level 4". In plain language this asks us to identify – in some detail - each step needed to complete MICE, how long each step takes, how much each step costs and on what basis we make these estimates. I interpret "basis" to mean documentary evidence, whether this means quotes or experience, it should avoid guess or worse and will be pertinent to questions asked by any subsequent review. The level of detail necessary depends on the complexity of the tasks and subtasks, but should identify the purchase of significant cost items and time steps. All smaller cost items can be rolled up as can short duration processes.

This work will produce a useful document which would be needed for the proposed independent review of MICE costs (ref).

WBS Organisation = Work Package Definition

MICE is a complex project which will ultimately brings together the work of many people and groups culminating in the operation of MICE as an experiment. MICE has already defined the major tasks – identified largely by their deliverables, e.g. coils, detectors, cavities etc (see http://hep04.phys.iit.edu/cooldemo/). Each of these tasks has associated with it one or two task leaders. It is proposed that initially the existing task leaders take responsibility for providing or identifying who will provide the WBS information.

The following list, taken from the MICE web sit, shows the original MICE task & technical leaders:

- Concept development: Rob Edgecock, Robert Palmer
- Experiment simulations: Gabriella Catanesi, Yagmur Torun
- Absorbers: Mary Anne Cummings, Shigeru Ishimoto
- RF cavities and power supplies: Helmut Haseroth, Derun Li
- Magnet systems: Mike Green, Jean-Michel Rey
- Detectors: Alan Bross, Vittorio Palladino
- Beamline: Paul Drumm
- RF radiation: Edward McKigney, Jim Norem
- Engineering integration: Edgar Black, Iouri Ivaniouchenkov

Additionally there is the

- Absorber & Focus Coils Working Group Mike Zisman

This roughly translates to the following table:

WP	Package Title
4	**Muon Beam Line & Infrastructure**
4.1	Beam Line
4.2	Infrastructure
5	**RF Systems**
5.1	RF Cavity
5.2	RF Power
6	**Magnets & Absorber**
6.1	Absorber
6.2	Focus Coil
6.3	Coupling Coil
6.4	Tracker Solenoid
7	**Detector & Measurement**
7.1	Tracker – SiFi
7.2	Tracker – TPG
7.3	TOF
7.4	Ecal
7.5	Cherenkov
7.6	DAQ System
7.7	Simulation & Analysis Software
8	**Module Integration**
8.1	Tracker & Solenoid
8.2	Absorber & Focus Coil
8.3	Cavity & Coupling Coil
9.	**System Integration**

However, integration of various parts into modules (Package 8) is not logically covered. I prefer the following rearrangement that divides MICE into modules, assigning each module a (manager/and where appropriate a deputy). The absorber & focus coil working group is a good example that this is both a necessary step and also a successful methodology.

MICE Integration (II/EB$_L$)

- **1 Beam & Infrastructure** (II/PD)
  - 1.1 Muon Beam (PD)
    - 1.1.x Beam Line Control
  - 1.2 Civil Engineering (II)
  - 1.3 Cryogenic System (TB)
  - 1.4 Plant (II)
  - 1.5 Hydrogen System Infrastructure (TB)
  - 1.6 RF Power System Infrastructure (RC/HH)
  - 1.7 Integration & Interface (II)
- **2 RF Power Systems (RC/HH)**
  - 2.1 Design (RC)
  - 2.2 Beg (RC)
  - 2.3 Borrow (RC)
- **3 Absorber & Focus Coil Module (MZ)**
  - 3.1 Focus Coils (GB/EB$_A$)
  - 3.2 Absorber (MAC/SI)
  - 3.3 Hydrogen System (MG/TB)
  - 3.4 Installation & Interface (MZ)
- **4 Cavity & Coupling Coil Module (MG)**
  - 4.1 Cavities (DL)
  - 4.2 RF Power System Interface (DL/RC)
  - 4.3 Coupling Coil (MG)
  - 4.4 Installation & Interface (MG)
- **5 Detectors & Measurement (AB/VP)**
  - 5.1 Up stream (?)
    - 5.1.1 Emittance Control (BP)
    - 5.1.2 TOF (?)
  - 5.2 Tracker Module (AB)
    - 5.2.1 Tracker Solenoid (VP)
    - 5.2.2 Tracker Detector (KL/ER) + Hardware and Services
    - 5.2.3 Tracker Detection Electronics (AB/ER)
    - 5.2.3 Installation & Interface (AB)
  - 5.3 Down Stream (?)
    - 5.3.1 Ecal (?)
    - 5.3.2 Cherenkov (?)
    - 5.3.3 PID (?)
    - 5.3.4 Installation & Interface (?)
  - 5.4 Data Acquisition (?)
    - 5.4.1 DAQ (?)
    - 5.4.2 Installation & Interface (?)
  - 5.5 Analysis & Simulation Software (GC/YT) or (BP/RE)
  - 5.6 Detector Performance Tests (EMcK/JN)

Installation means being able to sit it on the floor, cable up & plumbing in.
Interface means making it work or fit in with surrounding equipment.

Some of the packages will require more development of the WBS than others. The Infrastructure package in particular involves many deeper level tasks: Cryogenic & Hydrogen System, Civil Engineering etc. The aim of the WBS is to identify those items which drive the cost (fixed cost items purchased from vendors, staff costs, for example), and those which drive the planning (e.g. delivery times, resource conflicts, finance availability). Clarity is also important and I believe the above structure provides this. An example of the depth of breakdown is shown in the final figure. This example of a fictitious work package is developed to level 4 if it is considered to be embedded in a larger project. It is fully developed on the basis that further subdivision provides no more useful information.

The preparation of a fully developed WBS is used to identify the following information:

Information	**Example**	**Comment**
Fixed Costs	Cost of Power Tube	Specification, ordering, delivery would be part of the preceding chain of processes.
Fixed Dates/ Predecessor	Start of a Shutdown	
Fixed Durations	Shutdown	It can be the case that a task can be completed in (say) a month, but requires less working time than this to complete – possibly because of resource commitments outside of MICE.
Staff Resources	Mechanical Designer, Mini Mouse	Identification of staff, either by skill or a named individual.
Work	Days of effort required for Task	If the work is not limited by resource availability outside of MICE, then this is also the process/task duration.
Work Cost	Cost of effort = work x work rate	This can be different for different groups. I will need advice.
Resources	MICE Hall, Lab G	This may be useful later during installation, e.g. crane use during installation.

I will use Microsoft Project to hold the information. Information can be exchanged in MSProject format or in an Excel worksheet – I will generate a template Sheet that can be used if this is the case.

Time scale

At the moment the proposed external review has not been defined, but I think this will drive our time scale. I will be proactive to get the information that we need, but afterwards I will rely on getting amendments as required.

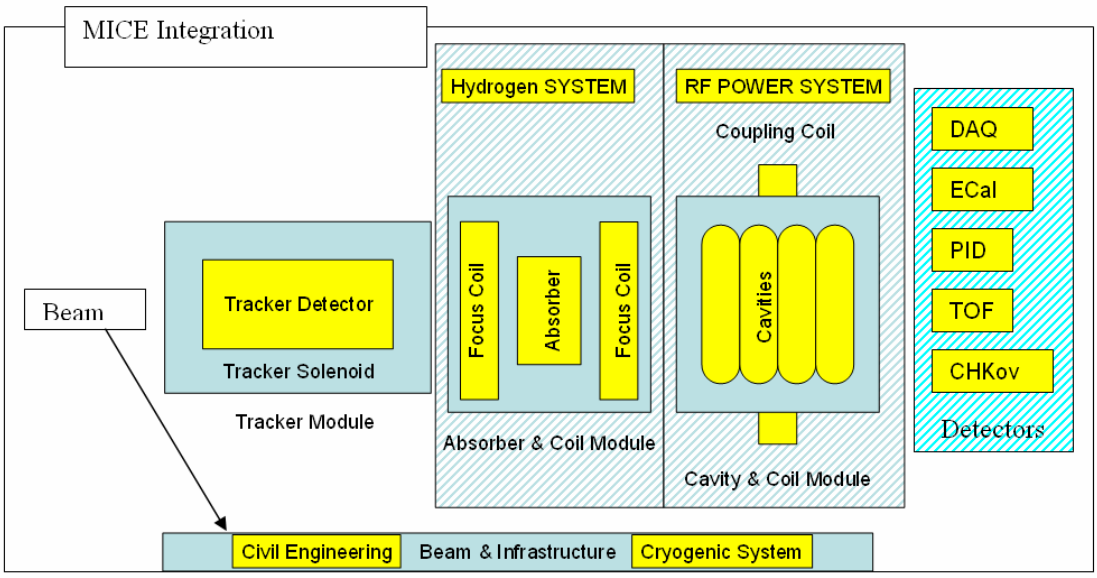
Version Control

Once the initial compilation is complete, I suggest issuing changed information at the same time as the steering meetings. We can review this as necessary, or as the MICE constitution comes into effect.

Key to WP Manager's initials:

AB: Alan Bross
BP: Bob Palmer
DL: Derun Li
EB$_L$: Ed Black
EB$_A$: Elwyn Baynham
EMcK: Ed Mckigney
GC: Gabriella Catanesi
HH: Helmut Haseroth
II: Iouri
KL: Ken Long
JN: Jim Norem
MAC: Mary Anne Cummings
MG: Mike Green
MZ: Mike Zisman
PD: Paul Drumm
RC: Roy Church
RR: Bob Rimmer
SI: Shigeru Ishimoto
TB: Tom Bradshaw
VP: Vittorio Palladino
YT: Yagmur Torun

Hierarchical Work Package Assignment Strongly Linked to Deliverables



Example WBS to "Level 4"

CCLRC Rutherford Appleton Laboratory

"WBS to level 4"

1 FTM Work Package
- 1.1 Design
  - 1.1.1 Specification
  - 1.1.2 Calculation
  - 1.1. Sign off
- 1.2 Production
  - 1.2.1 Vendor discussion
  - 1.2.2 Tender process
  - 1.2.3 Place Order
  - 1.2.4 Wait delivery
  - 1.2.5 Inspect & Acceptance
- 1.3 Testing (at Contributor site)
  - 1.3.1 Design test programme
  - 1.2.2 Setup test area
  - 1.2.3 Complete tests
  - 1.2.4 Sign off
- 1.4 Installation at RAL
  - 1.4.1 Package up
  - 1.4.2 Post off
  - 1.4.3 Deliver
  - 1.4.4 Site preparations
  - 1.4.5 Installation
  - 1.4.6 Test
  - 1.4.7 Sign off

Level 4

Defines
– who
– how long (duration – work done)
– how much (materials - $/£/€/¥)

$/£/€/¥

Identifies
– resource conflicts

Format:
EXCEL SHEET
MS PROJECT