Defining Commissioning Process/Tools using Model Quality Control Matrix

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Purpose

Work program

Work organisation

Private area

Annex 40

Commissioning of Buildings and HVAC systems for Improved Energy Performance

Program of the International Energy Agency (IEA)

Model Quality Control

- Model Quality Control is a general model that can be applied for all kinds of processes (building and building services, industrial etc.).
- In the Netherlands the MQC structure is elaborated for heating systems and domestic ventilation systems.
- In the Annex 40 Japan has developed a complete tool to define any kind of MQC for HVAC and other building services systems, and elaborated for Standard Model Commissioning Process for HVAC of non-residential complex buildings.

MQC_Continued

- The intention of MQC is to control the total production process including developing specifications, design, construction, acceptance and operation.
- It focuses on avoiding failures on all strategic aspects and moments in this process.
- It contains all operational techniques and activities, necessary to realize a defined level of quality.
- In this framework "Quality" means that the delivered performance matches the required and precisely formulated requirements and expectations of the principals, including time planning, budgets and all technical aspects.

Model Quality Control Matrix

- The most important characteristic for MQC for HVAC systems is a structure that follows all the process phases. This enables to build in a number of strategic decisions in the (building) process and to assess if the system meets the targets and requirements, as defined in the program phase.
- The total quality is determined by several aspects (not only technical but also financial, organization and communication), which lead to a so-called MQC matrix combined with commissioning phases.
- Thus, *MQC matrix* consists of cells and their contents in several hierarchy, positioned at the intersections of phase axis and aspect axis.

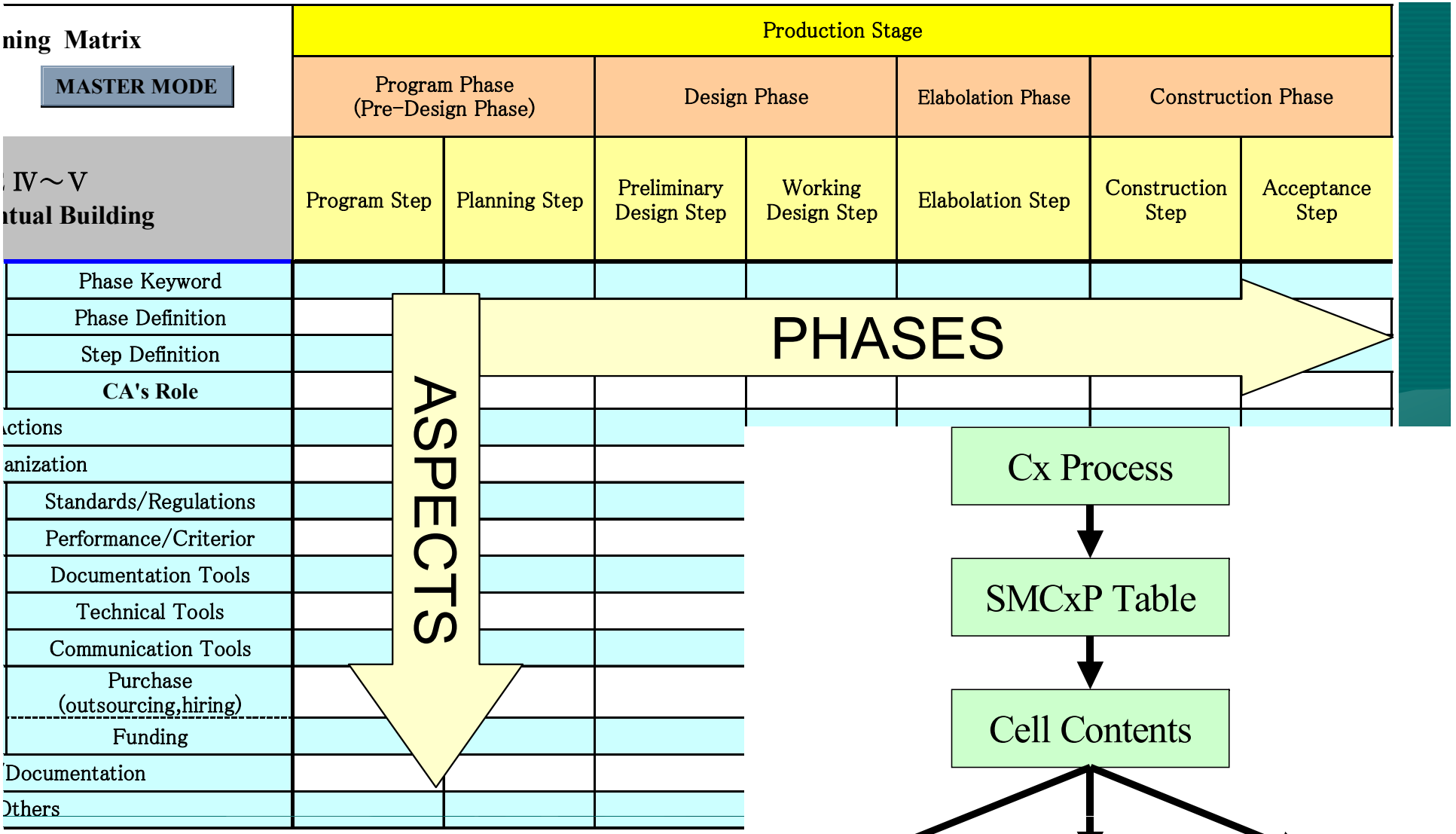


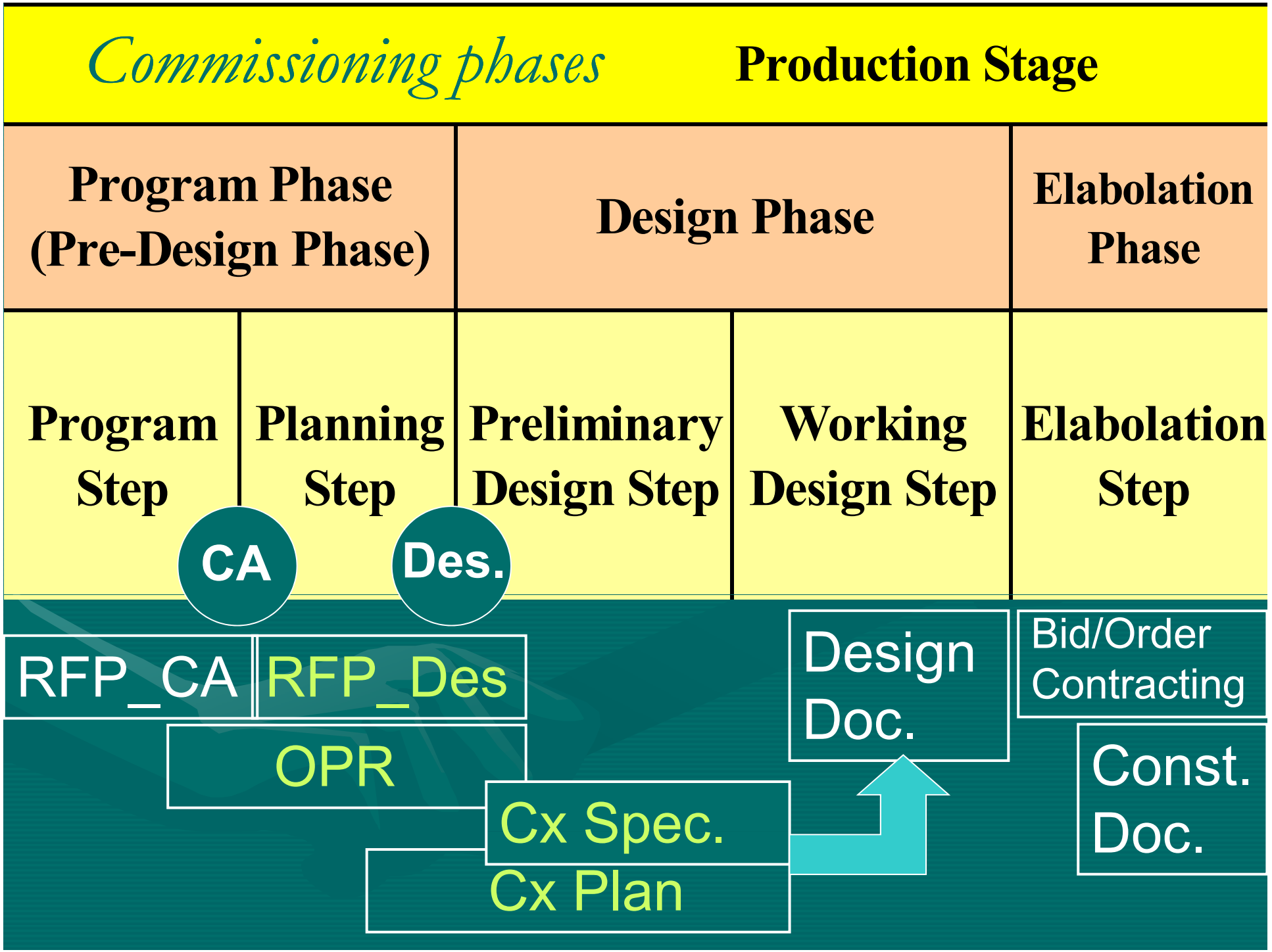
Figure B: MQC Matrix.

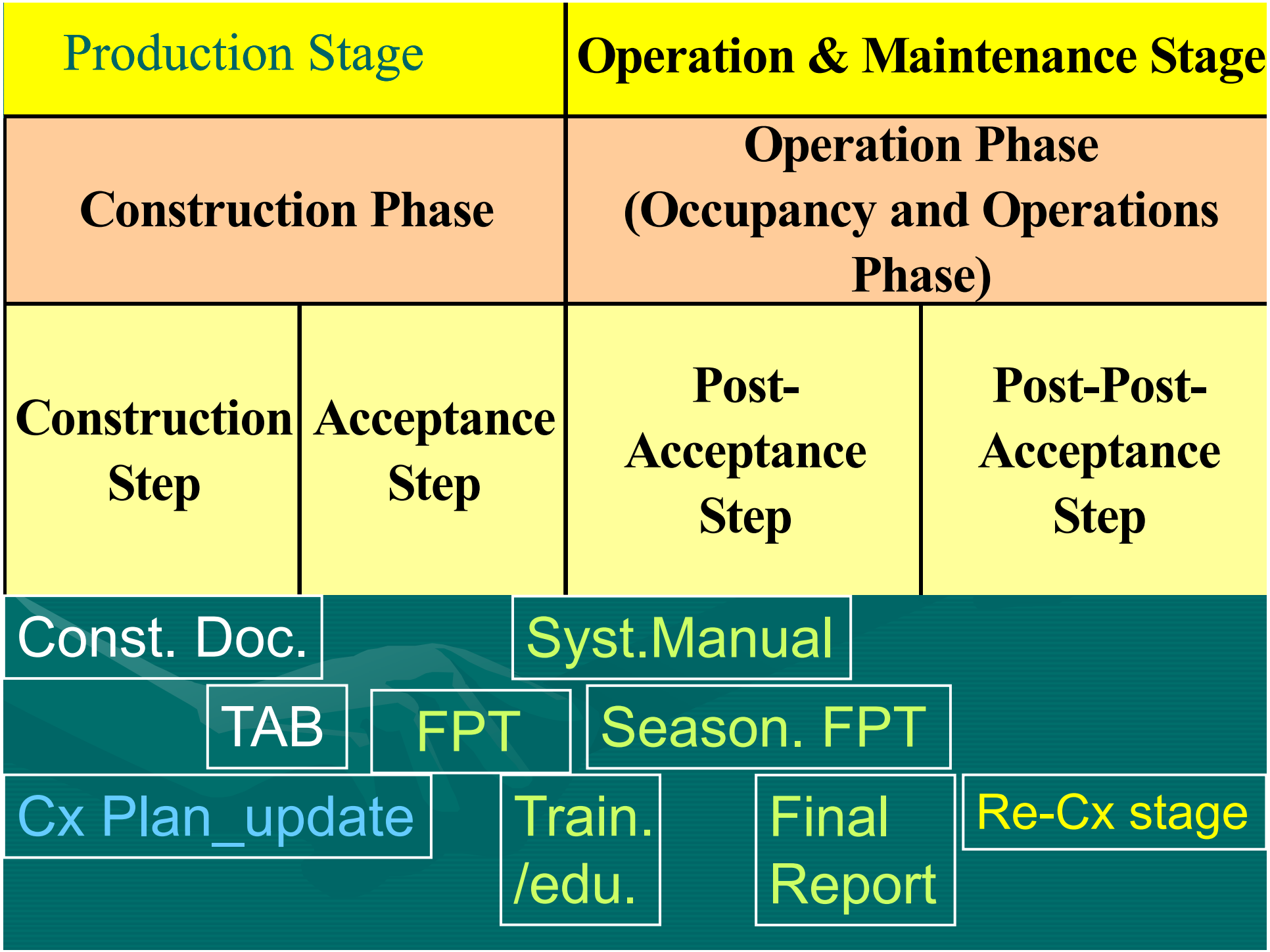
Structure of MQC Matrix
-Commissioning Process sheet

Figure A: Structure of MQC Matrix.

Commissioning Phases and Aspects

- The definition of phases and steps of the commissioning process can be referred to by linking to glossary at the Annex40 website.
- The Aspects are defined for each phase and step in which not only the aspects for the commissioning authority himself but also the aspects for the main actors of the step and phase during the construction process are described in order that commissioning team members can correctly understand their own situations and relations among themselves to the success of commissioning process.


Commissioning phases
Production Stage
Program Phase (Pre-Design Phase)
Design Phase
Elabolation Phase
Program Step
Planning Step
Preliminary Design Step
Working Design Step
Elabolation Step
CA
Des.
RFP_CA
RFP_Des
OPR
Cx Spec.
Cx Plan
Design Doc.
Bid/Order Contracting
Const. Doc.


Production Stage
Operation & Maintenance Stage
Construction Phase
Operation Phase (Occupancy and Operations Phase)
Construction Step
Acceptance Step
Post-Acceptance Step
Post-Post-Acceptance Step
Const. Doc.
Syst.Manual
TAB
FPT
Season. FPT
Cx Plan_update
Train. /edu.
Final Report
Re-Cx stage

Aspects

Definition:

- In 'Phase Keywords' simple definitions of each phase and step are described.
- In 'Phase Definition' detailed definition and explanation are given to each phase and the same are done for 'Step Definition', in order that SMCP/MQC users can understand the meaning of these phases and steps.

Actions:

- Actions to be followed by the commissioning authority as well as principal actors in each step are described.

Aspects _continued

Organization:

- Members composing the commissioning team are listed.

Requirements:

- Inventory of internal and external requirements including a base level of legal requirements like buildings regulations, standards and others, as well as quality-related recommendations are described.
- Thus this aspect is subdivided into ‘Standards/Regulation’ and ‘Performance/Criteria

Aspects _continued

Commissioning Tools:

- 'Documentation tools' are most important to manage total commissioning process throughout.
- 'Technical Tools' are for performing actual commissioning items to be measured, tested, inspected, analyzed, simulated and evaluated for the purpose of verifying realization of OPR using test protocols and testing guidelines.
- 'Communication Tools' are also for management and actual execution of commissioning process by well-harmonized commissioning team.

Aspects _continued

Purchase/Finance:

- Necessary external expertise that has to be purchased, experts who have to be hired and outsourcing are described in 'Purchase'.
- Funding necessities and timing of funding shall be described in 'Funding'. Also, controlling and guarding of the object costs, i.e., HVAC installation, as well as the process costs (co-ordination, consulting, commissioning) are to be described.

Outcome/Documentation:

- Reporting of the input and output of all sequencing phases and evaluation of the process at the end of the steps, phases or at any other defined time interval due to contracts as well as the final commissioning report are to be edited and submitted.

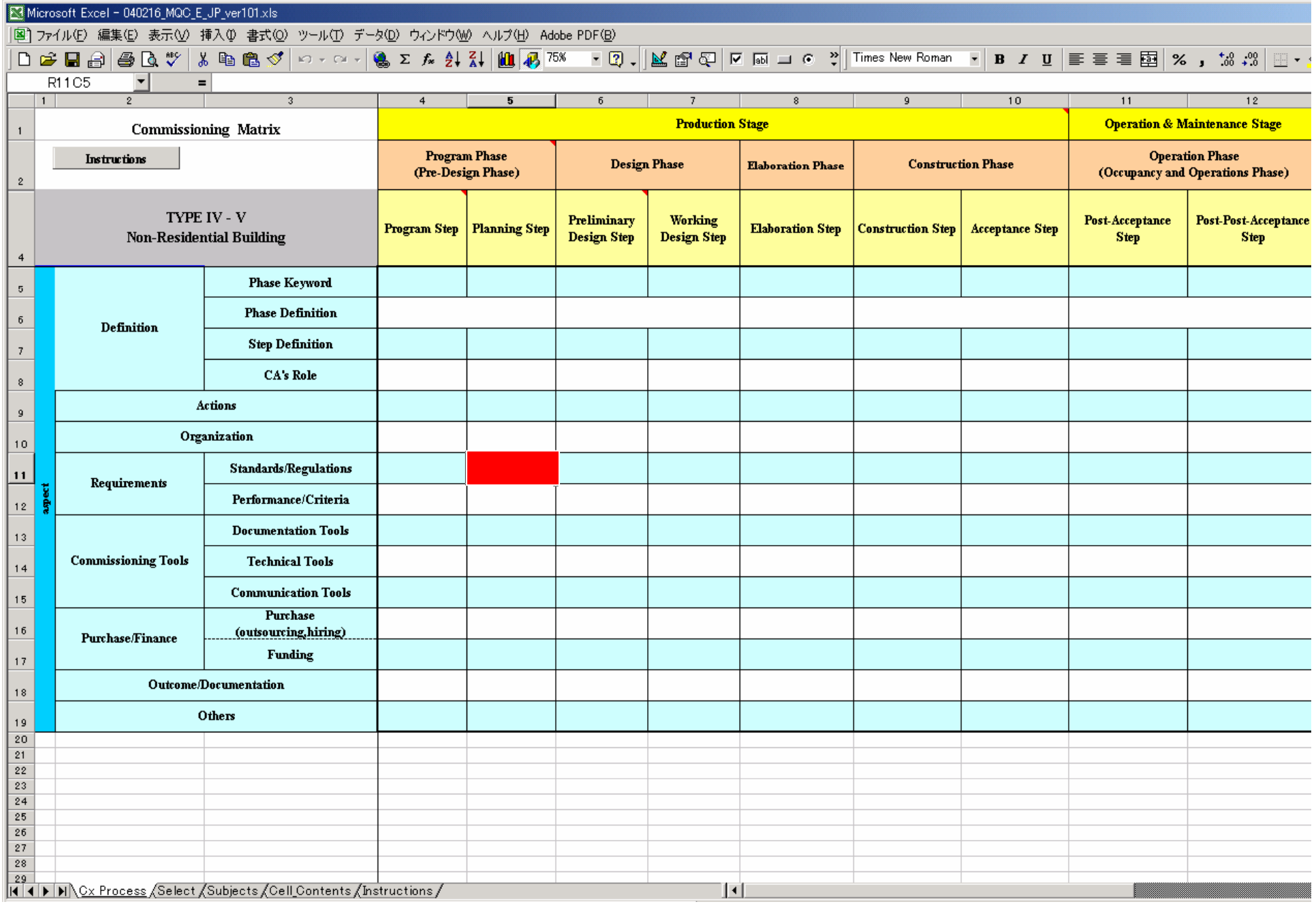
MQC tool software

- MQC tool has the functions to define the commissioning process for any Standard Model Commissioning and to be used for customization to specific project as the database including all the information during commissioning process by overriding, deleting and/or adding.
- The tool was developed with MS-Excel using macro program, one of the most popular software.

MQC tool software_continued

- Five sheets compose the developed Excel file of MQC tool.
  - 'Cx process'includes detailed information sheet to overview Cx process and select subject.
  - 'Select' sheet is a kind of table of contents.
  - 'Subject' sheet is a summery sheet of the objective process. If it is a Standard Cx. Process, it shall be called as SMCP/Type IV.
  - 'Cell contents' sheet includes detailed information that has the function to link to computerized documents, URLs or e-mail addresses.
  - "Instruction" sheet is an on-line manual how to use MQC tool.

'Cx Process' sheet



Microsoft Excel - 040216_MQC_E_JP_ver101.xls

Commissioning Matrix			Production Stage							Operation & Maintenance Stage	
Instructions			Program Phase (Pre-Design Phase)		Design Phase		Elaboration Phase	Construction Phase		Operation Phase (Occupancy and Operations Phase)	
TYPE IV - V Non-Residential Building			Program Step	Planning Step	Preliminary Design Step	Working Design Step	Elaboration Step	Construction Step	Acceptance Step	Post-Acceptance Step	Post-Post-Acceptance Step
aspect	Definition	Phase Keyword									
		Phase Definition									
		Step Definition									
		CA's Role									
	Actions										
	Organization										
	Requirements	Standards/Regulations									
		Performance/Criteria									
	Commissioning Tools	Documentation Tools									
		Technical Tools									
		Communication Tools									
	Purchase/Finance	Purchase (outsourcing,hiring)									
		Funding									
	Outcome/Documentation										
	Others										

Cx Process / Select / Subjects / Cell_Contents / Instructions /

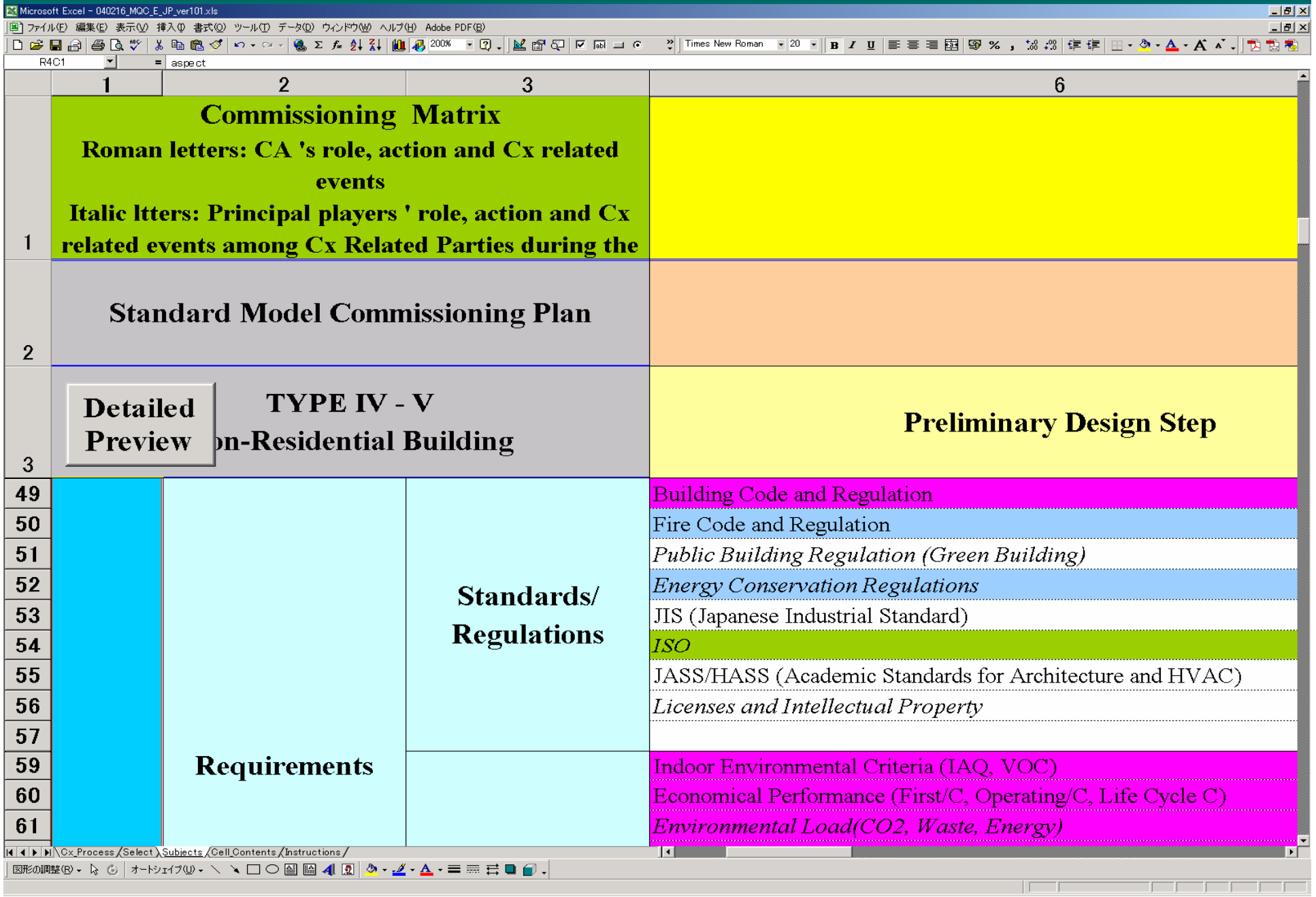
Production Stage	Program Phase (Pre-Design Phase)	Program Step	Select
		Planning Step	Select
	Design Phase	Preliminary Design Step	Select
		Working Design Step	Select
	Elaboration Phase	Elaboration Step	Select
	Construction Phase	Construction Step	Select
		Acceptance Step	Select
Operation & Maintenance Stage	Operation Phase (Occupancy and Operations	Post-Acceptance Step	Select
		Post-Post-Acceptance	Select

Select mode : [Aspect]

'Select' sheet

Aspect	Aspect2	
Definition	Phase Keyword	Select
	Phase Definition	Select
	Step Definition	Select
	CA's Role	Select
Actions		Select
Organization		Select
Requirements	Standards/Regulations	Select
	Performance/Criteria	Select
Commissioning Tools	Documentation Tools	Select
	Technical Tools	Select
	Communication Tools	Select
Purchase/Finance	Purchase(outsourcing,hiring)	Select
	Funding	Select
Outcome/Documentation		Select
Others		Select

'Subject' sheet (a part)



'Cell Contents' sheet (a part)

Step	Aspect	Aspect2	Subject
Preliminary Design Step	Requirements	Performance/Criteria	Indoor Environmental Criteria (IAQ,

Save&Close | Erase of Now Input | Deletion of this cell contents

cell contents data

Cell Contents	Specification	Specification2	URL	MAIL	Other Files
Harmful Chemicals	Formaldehyde				
	VOC	Toluene			
Dust	Dust concentration or number of counts				
Fine Particles	Count Number of Particles (Clean Room)	class 100			
Temperature and Humidity	DB Temperature	room average			
		control point value			
		occupied zone average			
		distribution			
	RH Relative humidity				
	ET*	control zone			
		reset schedule by OA compensation			
	PMV				
Bio-Pollution	Mold				
	Pollen				
Noise (indoor/outdoor)					
Lighting					
Smell					

Step	Aspect	Aspect2	Subject
Planning Step	Requirements	Performance/Criteria	*Green Building Rating System*

Save&Close　Erase of Now Input　Deletion of this cell contents

cell contents data

Cell Contents	Specification	Specification2	URL	MAIL	Other Files
LEED, USA	introduction				Introduction.pdf
	Energy and atmosphere				Energy and Atmosphere.pdf
CASBEE, Japan	introduction				Casbee.pdf

Step	Aspect	Aspect2	Subject
工事発注段階 (Elaboration Step)	コミッショニングツール (Commissioning Tools)	技術ツール (Technical Tools)	各種設計ガイドライン及びマニュアル

保存&閉じる　展開時の状態に戻す　すべての内容を削除する

cell contents data

Cell Contents	Specification	Specification2	URL	MAIL	Other Files
蓄熱システムの設計・制御（第1編、第2編、別冊）	蓄熱システムの設計・制御に関連するマニュアル	(財)ヒートポンプ・蓄熱センター	http://www.hptcj.or.jp/chikunetu/tools/index.html		
氷蓄熱式空調システムマニュアル(計画・設計編、低温送風空調システム設計編)	氷蓄熱システムの設計・制御に関連するマニュアル	(財)ヒートポンプ・蓄熱センター	http://www.hptcj.or.jp/chikunetu/tools/index.html		
病院施設の水蓄熱システム	病院施設で蓄熱システムを採用した場合のモデル設計例	(財)ヒートポンプ・蓄熱センター	http://www.hptcj.or.jp/chikunetu/tools/index.html		
老人保健施設の水蓄熱システム	老人保健施設で蓄熱システムを採用した場合のモデル設計例	(財)ヒートポンプ・蓄熱センター	http://www.hptcj.or.jp/chikunetu/tools/index.html		
高層オフィスビルの水蓄熱システム	大規模事務所・店舗施設で将来のエネルギー情勢を考慮した複合熱源の蓄熱空調システムを採用したモデル設計例。	(財)ヒートポンプ・蓄熱センター	http://www.hptcj.or.jp/chikunetu/tools/index.html		
大規模店舗ビルの水蓄熱システム	商業施設においてエネルギーの安定性、エネルギーコストの観点から複合熱源を採用したモデル設計例	(財)ヒートポンプ・蓄熱センター	http://www.hptcj.or.jp/chikunetu/tools/index.html		
事務所ビル(新設)の氷蓄熱システム	新築事務所建物の氷蓄熱システムのモデル設計例	(財)ヒートポンプ・蓄熱センター	http://www.hptcj.or.jp/chikunetu/tools/index.html		
事務所ビル(リニューアル)の氷蓄熱システム	事務所ビルで空調設備を非蓄熱方式から蓄熱方式へ転換したリニューアルモデルの設計例	(財)ヒートポンプ・蓄熱センター	http://www.hptcj.or.jp/chikunetu/tools/index.html		

Operation of MQC

Two functions of MQC tool.

- One is the organized database management of commissioning process to accomplish commissioning project. Using this function, users can describe the information on the blank MQC and define the commissioning process.
- The other is browsing the selected information from the commissioning process database. User can browse the necessary information for commissioning.

Defining MQC

- After start-up of the MQC, user defines information of commissioning process on “Subject” sheet.
- The menu box, which will appear by double-clicking, is used for inputting information.
- By selecting “New Input” button showed in the menu box user can input the information into the cell.

Defining MQC_continued

- By double clicking any other cell the inputted information will be registered on the database. Thus, the user can modify, copy or delete the information in the same manner.
- When user selects “Detailed Input”, detailed cell contents appear and now he can define more detailed contents about inputted information.
- These contents can be linked with the computerized documents, URLs or e-mail addresses. This function uses the hyperlink function on the MS-Excel.

Browsing Information

- Users select and double-click an intersection of a phase and aspect on the "Cx Process" sheet.
- Then detailed key information of the database, that is, the first column of the cell contents sheet of the desired cell appears on the left window of menu box.
- There is a window to select phases and aspects at the right side of menu box. User can browse the different information by changing phases and aspects from here.
- Using "Select: Subject" window at right center user can obtain more detailed information included in cell contents sheet by clicking "Detail review" button.

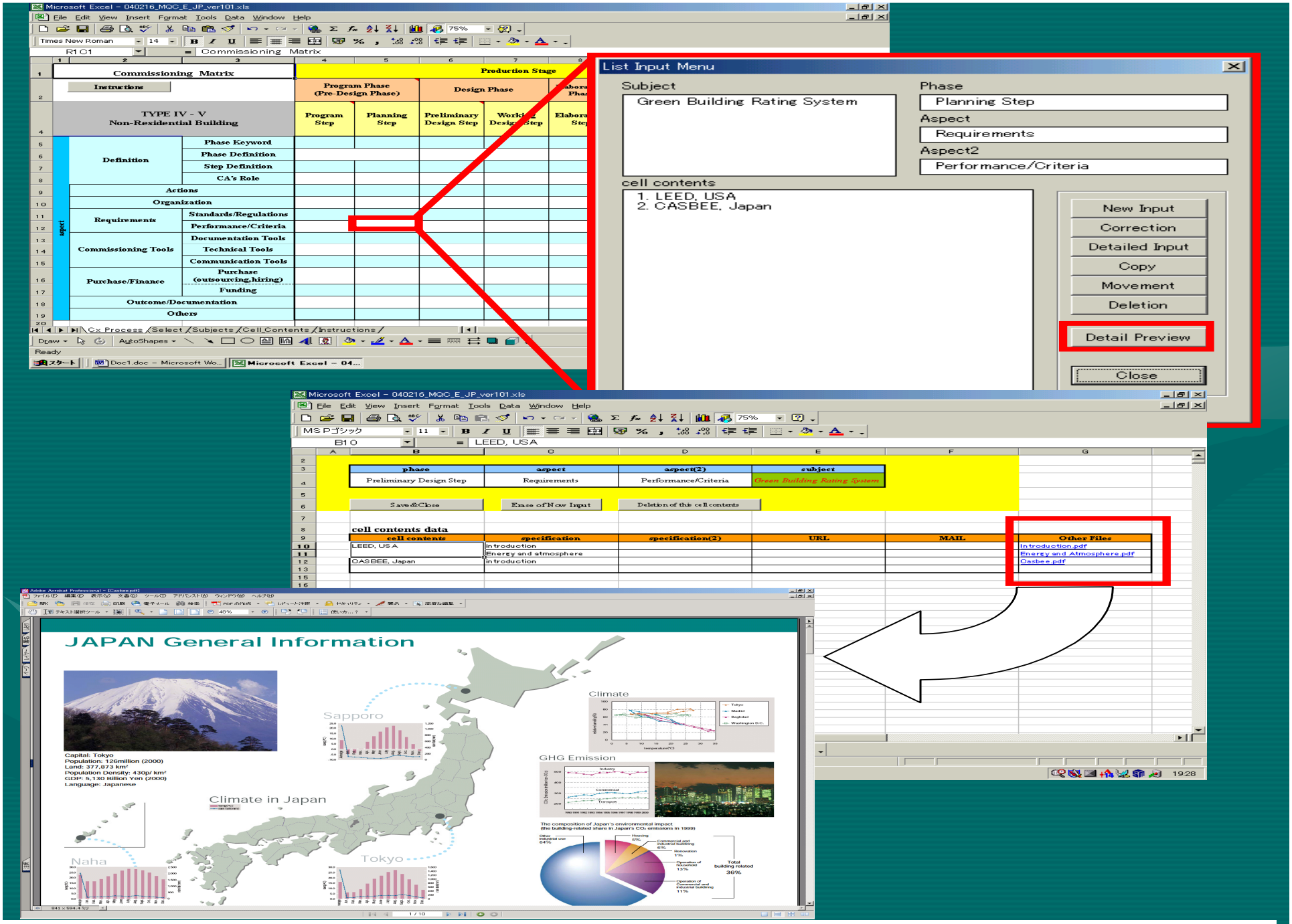


Figure I: Information Browsing Flow


Demonstration follows.

Application

- **Standard Model Commissioning Plan**
  - All kinds of information can be linked from the top sheet by way of the selected matrix cell. All the cell contents should be replaced according to users' social and technical environment, if necessary.
  - This has been one of the principal object of Annex 40.

Application_continued

- **Project Oriented Quality Control**
  - Customization of MQC for any specific project. Specific name, contact address, email address and likes of each commissioning team shall be filled in.
  - The cell contents include commissioning tools, documents which were used in the projects and test reports, etc.
  - The customized electronic MQC also includes commissioning plan, commissioning specification, commissioning report and any other products of commissioning implementation.

Application_continued

- **Electronic Commissioning Guideline**
  - If all the cell contents, for example, all of a certain HVAC commissioning process guideline, are fully inputted, then electric commissioning guidelines and tools are obtained in a single MQC matrix with the full of database and technical tools included.
  - Existing information, documents and formats are cited and/or linked directly in or from the cell contents. Users can find whatever they wants, whenever the phase and step are and whoever they are.

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