UNIVERSITY OF STRATHCLYDE

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

EXPLORING THE INTERACTION BETWEEN THE INTERNATIONAL RADIO SPECTRUM MANAGEMENT REGIME AND NATIONAL RADIO SPECTRUM MANAGEMENT POLICIES

APPENDICES

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A thesis presented in fulfilment of the requirements for the Degree of Doctor of Philosophy at the University of Strathclyde

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Appendix I: Previously Published Work

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10. El-Moghazi, M., Whalley, J. And Irvine, J. (2014) " International Spectrum Management Regime: A Gridlock in the Way of Spectrum Property Rights?" proceeding of the ITS Biennial Conference, November, Rio de Janeiro.

Appendix II: List of Interviewees

The interviewees were 22 from Egypt, 13 from UAE, and 77 from the international spectrum management community.

The complex interaction between the member states and the private sector within the ITU-R as shown in chapter 5 has largely influenced the selection of the interviewees outside the two selected cases that should reflect the views on the research question in general from the perspective of the international community. It was decided eventually that the interviewees sampling criterion should include all participants that are involved in activities related to the research questions and also aware of the related ITU-R.

Appendix III: Sample of an Interview Transcription

The researcher: let me first ask you: What are views with such concept of having this neutrality with regard to radio communication service allocation?

Interviewee: Well, our frequency law is based on the principle of having service and technology neutrality where it is feasible and possible. There is of course trade-off between flexibility and sometimes efficiency. To be more precise, especially within mobile, we of course have the flexibility for operators to use and choose the technology they prefer within the IMT2000 that is they can choose 3G, LTE or even using 2G in the different frequency bands.

The researcher: All right. Just to clarify. Is it service neutrality in terms of ITU radio communication services?

Interviewee: Yes, they have from a frequency point of view the possibility to choose the allocated spectrum to mobile for 2G, 3G and LTE technology. There might be in the individual license certain requirements they have to fulfil, but how they fulfil those requirements is up to them; we are not specifying in what way or by which technology they have to fulfil the requirements.

The researcher: So let me ask you about the concept of WAPECS. I've been following the development of such concept, and to my understanding it was about radio communication service, and technology neutrality. What do you think of such concept?

Interviewee: The concept has been developed in the EU in the RSPG and should apply wherever it is possible and make sense. In certain services, especially in mobile service, it is possible to a large degree to use the WAPECS concept. In other areas it might be more difficult because we have allocated frequency bands to be used by satellite communication and sometimes satellite communication does not go along with other kinds of services.

Appendix IV: Data Preparation Verification Process

The first step after transcribing the interviews was to send the transcribed files to the interviewees in order to revise the transcription document of the interview and to provide the researcher with any additional views. Several interviewees edit their transcribed interviews removing or highlighting some parts. For instance some interviewees required removing some sensitive information or not mentioning specific countries names and replacing it by developed or developing countries according to the case. However, one interviewee decided after conducting the interview and transcribing it to withdraw his data and not to participate in the research. Accordingly, his data was removed and not used.

Appendix V: Data Coding Steps

Firstly, the final form of the transcription of the interviews was imported into NVivo as Microsoft word files along with the list of the interviewees and their classifications (e.g. Egyptian case study, international interviewees). These transcribed interviews are called 'sources' by NVivo. The second step in the coding process is to create codes. Coding in Nvivo is stored in what is called "nodes" where is concept is associated with a node (Bazeley, 2007). More specifically, a node is defined as a collection of references about a specific theme and coding with Nvivo is defined as the process of marking passages of text in a document with nodes (Bryman and Bell, 2007).

In general, Miles and Huberman (1994) advocate three strategies for coding. The first strategy is a priori one, which is to create initial provisional list of codes driven from the research questions, hypotheses, or conceptual framework. The second strategy is inductive one where no codes are identified before obtaining them from the data. Such strategy could be used with grounded theory research method. The third strategy is a pathway between a priori and inductive approaches where a general scheme of codes is created based on the general domains in which codes can be developed inductively. The researcher adopted the third strategy and developed an initial list of general codes that were driven from the conceptual framework and then started to define more new codes while going through the data. This has helped the researched being focused during the coding process while being able to notice new emerging themes.

The NVivo program accommodates two types of coding that were used in the data reduction stage. The first is open coding which requires breaking down the data and categorising it into concepts and the second is axial coding which connect and structure the different concepts (Bryman and Bell, 2007). Accordingly, the third step in the coding process was open coding and it resulted in 81 nodes which all of them are free nodes. In the beginning of the open coding, the researcher selected one of the longest interviews that covers all of the three research questions to start the coding with. This first interview resulted in creating 45 nodes. Moreover, after coding 10 interviews, no new nodes were added which indicated that the coding process was

robust in terms of not missing a concept. There was a need to re-code these first 10 interviews to make sure they were coded by all of the new nodes created. Below is a snapshot of these initial nodes.

Name	Sources	References
2G Technology Neutrality	3	6
3G Technology Neutrality	1	2
700 MHz - 800 MHz	2	2
700 MHz - Before WRC-12	2	2
700 MHz - Europe Position	21	33
700 MHz - Others	1	1
700 MHz Africa	4	4
700 MHz- During WRC-12	2	3
700 MHz Issue	46	67
Confusion between Service Flexibility and Technology Neutrality	3	3
Confusion between Telecommunication Services and Radio Services	3	4
Decision Making Procedures in CEPT	9	18
Developing Countries	25	34
DFS-TPC	23	27
General Statement	38	46
Influence of AI 1.19 Decision on TVWS	43	44
Influence of Broadcasting on TVWS	3	4
Influence of EC on CEPT	12	18
Influence of IMT on LTE Development	1	1
Influence of IMT Process in Reaching One Radio Interface	19	24
Influence of IMT Process on WiMAX Development	36	56
Influence of ITU-R Decision Making Procedures on Service Flexibility	40	45
Influence of ITU-R on Opportunistic Access	78	127
Influence of ITU-R on Service Flexibility	64	119
Influence of ITU-R on Technology Generation Definition	53	75
Influence of ITU-R on Technology Neutrality	79	188
Influence of ITU-R on WAPECS	17	22
Influence of National Regulations on TVWS Development	1	1
Influence of Non- European Countries in CEPT	13	20
Influence of Regional Organisation in ITU-R	28	53
Influence of Spectrum Designation on Technology Neutrality	29	37
Influence of WiMAX on Technology Neutrality	18	24
Interaction between Service Flexibility and Opportunistic Access	5	6

Interaction between Service Flexibility and Technology Neutrality	9	9
Interaction of Operator with ITU-R	20	34
Interference due to Opportunistic Access	3	6
Interference due to Service Flexibility	10	11
Interference due to Technology Neutrality	5	6
Issues Associated with Technology Neutrality	1	1
LSA-ASA	18	24
Neutrality between 2G and 3G	7	11
Neutrality between 3G and 4G	8	11
Operator Interaction with Regulator	3	4
Perception of 2G Definition	2	4
Perception of 3G Definition	5	7
Perception of 4G Definition	6	9
Perception of ITU-R IMT Standardisation Process	1	1
Perception on A Priori Planning	49	67
Perception on AI 1.19	7	11
Perception on AI 1.2	21	33
Perception on ATU	2	3
Perception on Convergence	7	10
Perception on Flexible Duplex Mode	13	14
Perception on Footnotes	41	46
Perception on Harmonisation	5	9
Perception on Interference	5	13
Perception on ITU Decision Making Procedures	19	27
Perception on ITU-R Service Definitions	58	68
Perception on ITU-R Studies over TVWS	3	3
Perception on ITU-R System	21	24
Perception on ITU-R System Regime Theory	59	64
Perception on MIFR	40	41
Perception on Opportunistic Access	61	85
Perception on Service Flexibility	63	104
Perception on Sharing	3	4
Perception on Technology Neutrality	36	43
Perception on the Role of ITU-R Bureau	33	42
Perception on the Three Region System	66	73
Perception on TVWS Band by Band Study by ITU-R	31	31
Perception on TVWS ITU-R Decision	27	28
Perception on TVWS Licensing	1	1
Perception on TVWS Service Status	66	83
Perception on WAPECS	29	48
Quotes	9	12
Regulator Application of Opportunistic Access	9	10
Regulator Application of Service Flexibility	20	31
Regulator Application of Technology Neutrality	30	94
Regulator Dependency on ITU-R RR	3	5
Regulator Support to IMT Technologies inside WP	16	21

5D		
Relation between Service Allocation Flexibility and Opportunistic Access	1	1
Role of ITU in Resolving Interference	3	5

Figure 1: List of Free Nodes

In the stage of open coding, part of the text that represent specific concept is selected and then the researcher selects from the NVivo menu the related node (concept) and then it appears in the right side under this particular node as shown in the figure below.

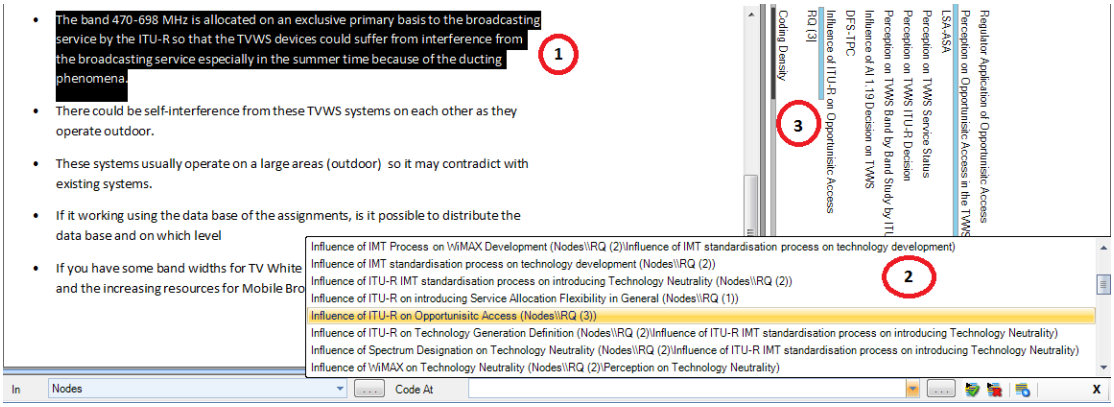

Figure 2: Steps of Open Coding

The fourth step in the coding process was to revise the free nodes to remove any repetition. It was found that some nodes are mentioned few times or by few interviewees which indicates that they are comments by specific interviewees rather than emerging concepts. These nodes were merged into other nodes that accommodate similar meanings. Some other nodes were merged to focus the analysis process on the main themes. Revising the codes could result in adding new codes to reflect new themes, recoding already coded text, and establishing new relations within the data (Miles and Huberman, 1994). The revision process has resulted in 44 nodes as shown below.

Name	Sources	References
700 MHz Issue	49	70
Developing Countries	25	34
DFS-TPC	23	27
General Statement	40	51
Influence of AI 1.19 Decision on TVWS	43	44
Influence of IMT Process in Reaching One Radio Interface	20	25
Influence of IMT Process on WiMAX Development	36	56

Influence of ITU-R Decision Making Procedures on Service Flexibility	40	45
Influence of ITU-R on Opportunistic Access	79	130
Influence of ITU-R on Service Flexibility	66	127
Influence of ITU-R on Technology Generation Definition	53	75
Influence of ITU-R on Technology Neutrality	79	191
Influence of Regional Organisation in ITU-R	29	56
Influence of Spectrum Designation on Technology Neutrality	31	39
Influence of WiMAX on Technology Neutrality	18	24
Interaction between Service Flexibility and Opportunistic Access	5	6
Interaction between Service Flexibility and Technology Neutrality	9	9
Interaction of Operator with ITU-R	20	35
Interference due to Opportunistic Access	3	6
Interference due to Service Flexibility	10	11
Interference due to Technology Neutrality	6	7
LSA-ASA	18	24
Perception on A Priori Planning	50	70
Perception on AI 1.2	21	33
Perception on Flexible Duplex Mode	13	14
Perception on Footnotes	41	46
Perception on ITU-R Service Definitions	63	76
Perception on ITU-R System	21	24
Perception on ITU-R System Regime Theory	59	64
Perception on MIFR	40	41
Perception on Opportunistic Access	63	91
Perception on Service Flexibility	64	105
Perception on Technology Neutrality	36	43
Perception on the Role of ITU-R Bureau	33	42
Perception on the Three Region System	66	73
Perception on TVWS Band by Band Study by ITU-R	31	31
Perception on TVWS ITU-R Decision	28	31
Perception on TVWS Service Status	66	84
Perception on WAPECS	29	48
Regulator Application of Opportunistic Access	10	12
Regulator Application of Service Flexibility	20	32
Regulator Application of Technology Neutrality	30	94
Regulator Support to IMT Technologies inside WP 5D	16	21
Role of ITU in Resolving Interference	3	5

Figure 3: Free Nodes after Reduction

The fifth step was to conduct axial coding where these free nodes are grouped together in the form of a tree which represents main themes and sub-themes. This tree accommodates three categories of nodes: free, parent, and child nodes. Free nodes do not contain any relationship or connection with each other. These free

nodes can be combined to formulate trees where there are parent and child nodes (Bazeley, 2007). Figure 4 below shows the difference between parent, child, and free nodes in addition to the trees. Furthermore, NVivo shows how many such node or concept were mentioned (references) and by how many interviewees (sources).

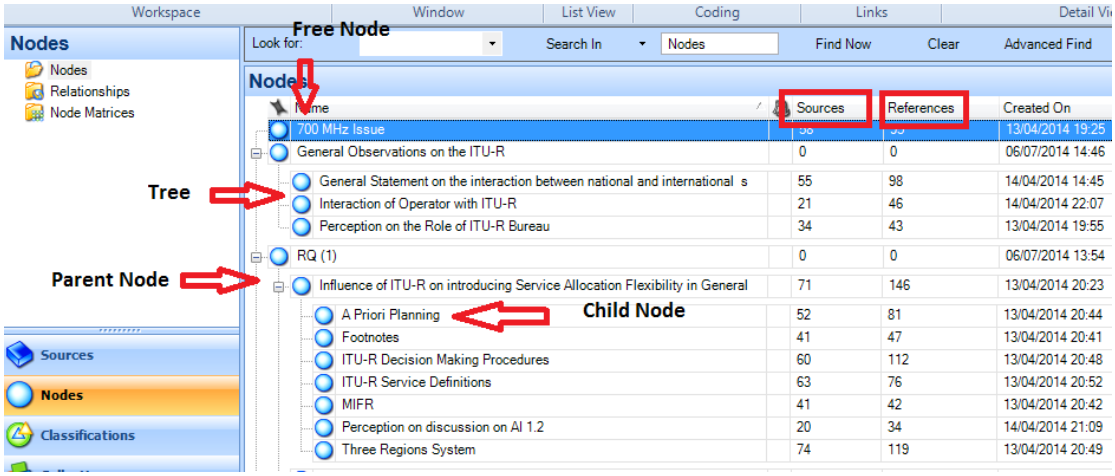

Figure 4: Free, Child, and Parent Nodes

Below is the structure of the nodes after axial coding as shown in Figure 5.

Name	Sources	References
700 MHz Issue	58	95
General Observations on the ITU-R	0	0
General Statement on the interaction between national and international spectrum regimes	55	98
Interaction of Operator with ITU-R	21	46
Perception on the Role of ITU-R Bureau	34	43
RQ (1)	0	0
Influence of ITU-R on introducing Service Allocation Flexibility in General	71	146
A Priori Planning	52	81
Footnotes	41	47
ITU-R Decision Making Procedures	60	112
ITU-R Service Definitions	63	76
MIFR	41	42
Perception on discussion on AI 1.2	20	34
Three Regions System	74	119
Perceptions on the concept of Service Allocation Flexibility	56	87
Perception on WAPECS	31	53
Regulator Application of Service Flexibility	20	32
RQ (2)	0	0
Influence of IMT standardisation process on technology development	0	0
Influence of IMT Process in Reaching One Radio Interface	22	27
Influence of IMT Process on WiMAX Development	36	57

Influence of ITU-R IMT standardisation process on introducing Technology Neutrality	80	197
Influence of ITU-R on Technology Generation Definition	55	82
Influence of Spectrum Designation on Technology Neutrality	42	56
Regulator Support to IMT Technologies inside WP 5D	16	22
Perception on Technology Neutrality	39	50
Influence of WiMAX on Technology Neutrality	19	25
Perception on Flexible Duplex Mode	13	15
Regulator Application of Technology Neutrality	30	96
RQ (3)	0	0
Influence of ITU-R on Opportunistic Access	79	131
DFS-TPC	24	29
Influence of AI 1.19 Decision on TVWS	46	53
Perception on TVWS Band by Band Study by ITU-R	32	32
Perception on TVWS ITU-R Decision	28	31
Perception on TVWS Service Status	66	84
LSA-ASA	18	25
Perception on Opportunistic Access in the TVWS	64	97
Regulator Application of Opportunistic Access	10	12

Figure 5: Nodes after Axial Coding

Coding was revised several times at the stage of open coding to remove repetition in coding or to code un-coded data, and also at the stage of axial coding to make sure the trees represent correctly the relations between the different concepts. It is worth also highlighting that there are some criticisms with the coding process which are losing the context of what is said and losing the narrative flow of what people say due to the fragmentation of the data (Bryman and Bell, 2007). While the first issue was overcome by coding the whole passage to make note of the context, the second was not a concern during the coding as most of the issues were not related and connected issues were coded on several nodes with the help of Nvivo.

In addition, during the coding process, some nodes were found to be not related to the research scope (e.g. Influence of EC on CEPT) or to be repeated. Furthermore, some nodes were perceived to have a wider scope so that it may accommodate other nodes within. Also, some nodes were kept although they have few references due to its importance and the difficulty to include them within other nodes. Other nodes were found to have low frequency and therefore, they were merged into similar nodes.

In addition, the Nvivo program accommodates several features that enable partial data analysis during the coding process. Firstly, it enables coding the same phrases several times to reflect the different aspects of it. For instance, the use of MIFR by TVWS was reflected in research questions 1 and 3. Secondly, important quotes were coded under separate free node called “quotes” so they could be retrieved easily with the concerned interviewee. Thirdly, the program enables the researcher to retrieve specific information at once (e.g. perception on technology neutrality by mobile operators in the Egyptian case study). Fourthly, phrases of particular importance could be annotated and have associated comment.

Fifthly, the Nvivo program arranges the transcribed interviews in an organised way showing the contribution of each interviewee on each node so that the number of the participants on each topic could be known easily. Sixthly, the feature of counting the number of sources/interviewees commenting on each topic enables the researcher to identify main concept. Moreover, the Nvivo features enable the researcher also to identify the interviewees on each topic and how much in percentage they focused on the issue.

In addition, the word searching option enables the researcher to find common links between the different concepts (e.g. relationship between the three research questions). The coding process has revealed also initial relationship between the three research questions. Several free nodes emerged as the research continued and were accommodated under a general node called ‘General observations on the ITU-R’. The NVivo features help also getting information on the contribution of each interviewee/source on the different concept/nodes and on which questions they have been involved as shown below

Node	Percentage coverage
Nodes\\700 MHz Issue	0.87%
Nodes\\General Observations on the ITU-R\Interaction of Operator with ITU-R	8.38%
Nodes\\RQ (1)\Influence of ITU-R on introducing Service Allocation Flexibility in General	8.42%
Nodes\\RQ (1)\Influence of ITU-R on introducing Service Allocation Flexibility in General\ITU-R Ser	2.48%
Nodes\\RQ (1)\Influence of ITU-R on introducing Service Allocation Flexibility in General\MIFR	1.55%
Nodes\\RQ (1)\Influence of ITU-R on introducing Service Allocation Flexibility in General\Three Re	2.82%
Nodes\\RQ (1)\Perceptions on the concept of Service Allocation Flexibility	12.22%
Nodes\\RQ (1)\Perceptions on the concept of Service Allocation Flexibility\Regulator Application of	18.23%
Nodes\\RQ (2)\Influence of ITU-R IMT standardisation process on introducing Technology Neutralit	2.47%
Nodes\\RQ (2)\Influence of ITU-R IMT standardisation process on introducing Technology Neutralit	4.86%
Nodes\\RQ (2)\Perception on Technology Neutrality	2.29%
Nodes\\RQ (2)\Perception on Technology Neutrality\Regulator Application of Technology Neutrality	41.20%
Nodes\\RQ (3)\Perception on Opportunisitc Access in the TVWS	8.69%
Nodes\\RQ (3)\Perception on Opportunisitc Access in the TVWS\Regulator Application of Opportun	13.76%

Figure 6: An Example of a Source Analysis

Appendix VI: Data Coding Verification Process

Check coding is an important process and accommodates checking the codes by more than one coder and it is considered as a good reliability check (Miles and Huberman, 1994). In order to verify the coding process, three independent coders were selected to double code some selected interviews. These coders were selected on the basis that they were not involved in any part of the research and that they have good knowledge of spectrum management and the ITU-R. Furthermore, one additional coder was chosen from outside the field of spectrum management in order to make the verification process more robust.

A protocol was designed for the code verification process that includes the systematic steps to enable the coders to verify the coding process In addition, a brief introduction was provided to the coders on the different research questions, coding process, and Nvivo program. Besides, a brief description was attached to each node so that coders get familiar with the research. Moreover, the coders signed a consent form confirming the deletion of all the data once the verification process has been completed.

A meeting was held with the coders after the verification process to discuss their comments and to seek any disagreement between them. The verification process revealed several important notes. Firstly, some areas were perceived to need additional coding on other nodes to reflect common areas between the different topics. These areas were revised to reflect such note. Secondly, several phrases were found not to be coded although they related to some particular nodes. This was handled by revising the whole data for vacant coding. Thirdly, the naming of the nodes was noted to cause some confusion to the reader and some nodes have quite similar names. These names were revised and modified accordingly.

Fourthly, some nodes were found to be similar and therefore, should be combined with each other. Fifthly, some child nodes were not coded in the firstly coded interviews because they were emerged after these particular interviews have been coded already. Therefore, these particular interviews were re-coded to reflect these emerging nodes. A second round of codding was conducted taking into

consideration the coders' comments. Any discrepancies between the coders were discussed in a group until an agreement is reached.

Protocol for Verification of the Coding Process

Each Coder is supposed to:

1. Open the four interviews transcripts from left pane from the sources/internals by double click.
2. A window that is containing the text file will be opened in the bottom view.
3. From the upper bar, select view, highlights, coding for all nodes.
4. From the upper bar, select view, coding stripes, selected items, select all, ok.
5. An additional pane should appear on the right side of the program containing all the nodes with colours on them where the text is coded with them and this coded text would be highlighted in the text pane.
6. As the number of nodes is relatively large, not all nodes would appear in the same window.
7. You should revise the text and you will find text that is not coded (highlighted). This means it is not relative to the different nodes. If you think this is not the case in your opinion, please note that by selecting the text, right click, links, annotation, new annotation, and then write your notes.
8. You should also revise the text and you will find text that is coded (highlighted). Some text is coded by more than one node. This means that is related to more than one node (concept). If you think the code is not correct or does not reflect the meaning of the text, please note that by selecting the text, right click, links, annotation, new annotation, and then write your notes.
9. In case that you have any other comments, kindly write that in a word file containing your comments.

Appendix VII: Data Display Steps

Mapping from text was utilised by Eden and Ackermann (2004) and it accommodates extracting arguments from the document by identifying short phrases which stand as a distinguishable element of an argument. These phrases are introduced in the Decision Explorer program by considering how each concept forms part of the overall network of arguments. Below is the protocol for mapping the different concept via the program Decision Explorer. It is mainly based on the steps suggested by Ackermann et al. (1992):

1. Separate the sentences into distinct phrases of no more than about 10-12 words long.
2. Build up the hierarchy by placing the goals at the top of the map and supporting these first with concepts indicating strategic direction and further on with potential options.
3. Identify the option and outcome within each pair of concepts. This provides the direction of the arrow linking concepts.
4. Ensure that a generic concept is superordinate to specific items that contribute to it.
5. In any pair of ideas look for the cause and effect/ means and end.
6. Retain interviewees' original language as much as possible.
7. The lengths of the concepts appearing in the map are shorter than those appearing in the text in order to ease reading the map. Therefore, each map is associated with explaining text.
8. Some texts were not mapped, as it does not need a map to clarify it.
9. Ackermann et al. (1992) point to a common pitfall in building a map which is to put the topic of the map as a concept as this will lead to most of the other concepts pointing to it. Therefore, the researcher was careful in differentiating between the main concepts in the map and the topic of the display.
10. The decision of the proper place of the concepts in the maps was driven mainly by the discipline inherited in the coding process.
11. The mapping processes were iterative where saturation occurred when there was no need to identify new concepts in the data displays

12. It should be noted that although the researcher considered sharing the maps with the interviews, this was not possible as most of the interviewees are concerned with one or few issues. So showing the full map would not make sense and comments on the whole map may not be relevant.

Appendix VIII: Data Display Verification Process

In order to verify the data display process, three independent mappers were selected to check the mapping of some selected concepts. These mappers were selected on the basis that they were not involved in any part of the research and that they have good knowledge of spectrum management and the ITU-R. Furthermore, one additional mapper was chosen from outside the field of spectrum management in order to make the verification process more robust.

A protocol was designed for the mapping verification process that includes the systematic steps to enable the mapper to verify the mapping process. In addition, a brief introduction was provided to the coders on the different research questions, mapping process, and Decision Explorer program. Moreover, the mappers signed a consent form confirming the deletion of all the data once the verification process has been completed. A meeting was held with the mappers after the verification process to discuss their comments and to seek any disagreement between them. The verification process revealed several important notes. Firstly, some concepts need clarification to be readable. Secondly, some concepts were missing from the diagram and need to be added. Thirdly, it was noted that concepts in the map should be in the order of they were mentioned in the text.

Protocol for Verification of the Mapping Process

Each Mapper is supposed to:

1. Open the file containing the three maps.
2. Read carefully the text.
3. Check the different elements of the maps reflecting the text.
4. In case that you have any comments, kindly write that in a word file containing your comments.

Appendix IX: Conclusions Verification Process

This research adopted four measures for conclusions verification: checking for representativeness, checking for researcher effect, triangulation, and weighting the evidence. Firstly, regarding the data, its quality can be tested via several measures. The first is checking for representativeness to ensure that the researcher has not conducted interviews with non-representative informants or generalise from non-representative events. As explained before, the researcher has conducted interviews with all possible informants at all seniority levels. In addition, all events in the ITU-R, UAE, and Egypt were followed through the period of the research to follow up any emerging events.

The second is checking for researcher effect which could be the effect of the researcher on the case or the effect of the case on the researcher. The former occurs when the researcher threatens the on going institutional relationship so that in some cases, the informants could not cooperate with the researcher. However, being active participant in the ITU-R discussions, members in ATU and ASMG, and an employee in NTRA enabled the researcher to win the participants' trust. Moreover, ensuring to the participants that their views are anonymous and will be used for the purpose of the research only encourage them to speak freely to the researcher. The latter type of bias could occur if the researcher is misled by some of the informants. This was mitigated by spreading out the types of informants to cover all managerial levels.

The third type of conclusions verification is triangulation which could include research method, data collection measures, and data sources. Due to several reasons, it was possible to triangulate the data sources only. Firstly, the time limitation of the research restricts the researcher's ability to use other measures of data collection. Secondly, the large number of interviewees required in return large number of hours conducting, transcribing and reviewing the interviews. Thirdly, it is argued that the triangulation of the data collection methods was overcome by the triangulation of the data sources within the interviews. More specifically, several informants or participants from the same category for each case study were interviewed (e.g. nine interviewees from UAE TRA). Fourthly, other methods such as questionnaires were found to be not effective due to the sensitivity of the information which may lead to low respondent rate.

The fourth technique is weighting the evidence. As explained by Miles and Huberman (1994:268) "*stronger data can be given more weight in the conclusion. Conversely, a conclusion based on weak or suspect data can be, at the least, held lightly and, optimally, discarded if an alternative conclusion has stronger data back of it*". According to the criteria defined by Miles and Huberman (1994), this research has met five out of six of having stronger data: seen or reported first-hand rather than heard second-hand, observed behaviour rather than reports or statements, field-worker is trusted rather than not trusted, collected in informal setting rather than formal one, and respondent is alone with the filed-worker rather than in presence of others. The only criteria left is having data collected after repeated contact which was not suitable due to the absence of need to contact the interviewees several times.

Appendix X: Conclusions Quality Assessment

The next step after drawing the conclusions and verifying them would be to examine the quality of the conclusions. Miles and Huberman (1994) identify five standards to assess such quality: objectivity (confirmability), reliability (dependability), internal validity (credibility), external validity (generalisation), and utilisation (application).

The first standard which is objectivity is concerned with the replicability of a study by others. More specifically, objectivity should assess among other aspects whether the research methods are explicitly described, data collection sequences can be followed, and conclusions are linked with data (Miles and Huberman, 1994). For this research, the sequence for how data were collected, coded, mapped for a specific conclusion were stated explicitly so that findings drawing could be replicated by others. Moreover, conclusions were supported by the literature where applicable and with interviewees' quotes as much as possible.

The second standard, reliability, refers to the extent to which data collection techniques or analysis procedures would result in consistent findings and it has four elements namely participant error, participant bias, observer error, and observer bias (Saunders et al., 2009). Participant error was overcome by choosing large number of interviewees and by interviewing several interviewees from the same category. In addition, participants or interviewees were given the chance to review their views by revising the transcriber interview.

Secondly, participant bias was overcome by similar measures used to handle participant error by selecting the maximum possible of interviewees under each category and also by selecting interviewees from all managerial levels especially within the two selected case studies (e.g. manager, director, and engineer), and also from all possible varieties within each category of interviewees (e.g. Mobinil, Vodafone, Etisalat from national mobile operators in Egypt). In addition, participant bias was relatively mitigated by confirming to the interviewees the anonymity of their views. Thirdly, observer error was overcome by using semi-structure interviews to inform a high degree of structure to the interviews and to unify the way of asking questions. Fourthly, observer bias was handled by replicating the interview transcription, coding and mapping process by observers other than the researcher.

The third standard, internal validity or credibility refers to whether the findings of the research make sense. This could be assessed by checking whether findings are

internally coherent, areas of uncertainty were identified, or conclusions are considered accurate by original informants among other measures (Miles and Huberman, 1994). While the first two measures were adopted for this research where the researcher searched for common areas between the three research questions and for any inconsistency and highlight them in the conclusions and research limitations, it was not possible due to the limitation in research time and large number of interviewees to get feedback on the conclusions.

The fourth standard which is generalisation or what is referred to by external validity is whether a research finding could be equally applicable to other research settings (Saunders et al., 2009). This was not one of the concerns of the research as the aim of the study was not generalisation but rather to explore the main research questions in a specific context or research settings. In addition, the reason of choosing multiple case studies was to compare the findings among the cases rather than to generalise the findings. The fifth standard named, utilisation or application criterion is concerned with the level of offered usable knowledge. This is clarified in the research contribution in Section 9.3.

Appendix XI: Examples of the Application of Technology Selection in Egypt

The WiMAX issue revealed that the support of NTRA to the inclusion of WiMAX into the IMT family of standards was not related to the introduction of the technology in Egypt as it was deployed as a fixed solution. Moreover, the support was a support to the fairness of the evaluation process within the ITU-R and to broaden the choices of mobile technologies in the market. The IBurst issue confirms that it is being IMT technology is essential to be introduced by the mobile operators. In addition, the issue shows that IMT identified spectrum is limited to IMT technologies.

Appendix XII: Examples of the Application of Technology Selection in UAE

The issue of WiMAX was discussed with the main stakeholders in UAE. The WiMAX issue confirms that being one of the IMT technologies is not a condition to introduce a technology in UAE. From the operators' perspective, introducing WiMAX in UAE was not related to the IMT standardisation as it was deployed as a fixed solution.

Appendix XIII: Examples of the Influence of IMT Standardisation on Perspectives regarding Mobile Technology Generations Definition in Egypt

One of the main areas that need further examination is the conflict between NTRA and Mobinil regarding the introduction of EDGE technology without obtaining a 3G license. The EDGE issue has shown the difference between the influence of the IMT standards on NTRA and operators' perception on 3G technologies. In particular, while NTRA considered EDGE to be one of the 3G technologies as it is one of the IMT-2000 standards, Mobinil envisioned EDGE as a 2G technology considering its lower capabilities comparing to 3G technologies.

Appendix XIV: Examples of the Influence of IMT Standardisation on Perspectives regarding Mobile Technology Generations Definition in UAE

The 4G technologies issue confirms the conclusion that there is no influence from IMT standards on 3G and 4G technologies definitions in UAE.

Appendix XV: Examples of Influence of IMT Spectrum Identification on Technology Selection and Technology Neutrality in UAE

The SDL issue has shown how TRA is technology neutral in practice. However, it could not confirm or refute that deployment of IMT technologies (e.g. LTE) is limited to IMT identified bands.

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