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CITI-SENSE Citizens' Observatories: Methodologies Assessment

Work Package 4

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Executive summary

This document is an assessment of the main CITI-SENSE methodologies developed, extended or adjusted, and implemented in the CITI-SENSE Citizens' Observatories (COs). The methodologies link the "products" and "services" elements from the chain "sensors-platform-products-users" on the CITI-SENSE Citizens' Observatories developed by the methods work packages dealing with sensor and communication platform and tools and services development (WPs 6-8) and implemented in the main field campaigns of the empowerment initiatives (WPs 2-3). Therefore, the methodologies assessed in this report are aligned with the main products and services described in D6.4 (Final Report on Methodology, Fredriksen et al., 2016) and D6.5 (Report on implementation and demonstration, Fredriksen et al., 2016), and the main Exploitable Knowledge Items (EKIs) identified in D9.15 (Exploitation Plan, Miorandi et al., 2016). They include:

1) Little Environmental Observatory (LEO)
2) CityAir Mobile App
3) Online Air Quality Perception Questionnaire
4) Environmental Monitoring Toolkit in Public Spaces
5) Data visualization Web Portal for Public Spaces Empowerment Initiatives
6) Data Visualization Web Portal for Outdoor Air Quality
7) Data Download Web Page
8) Citizens' Observatories Web Portal
9) Data Fusion Maps
10) Static Sensor Pack (AQMesh)
11) Spatial and Environmental Data Services Platform
12) Obeo radon sensor
13) Atmosphere sensor package

The following methodology assessment methods have been developed and used: 1) Usability Evaluation Form towards both internal and external users; and 2) Key Performance Indicators (KPIs) used by the internal methodologies developers and users. The assessment results are described in detail in Section 4.

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Abbreviations

Anonym	Full name
AQ	Air quality
COs	Citizens' Observatories
COT	Citizens' Observatories Toolbox
COWP	Citizens' Observatories Web Portal
DDWP	Data Download Web Page
DNN	DotNetNuke
EI	Empowerment Initiative (case study)
EKIs	Exploitable Knowledge Items
GEOSS	Global Earth Observation of System of Systems
KPIs	Key Performance Indicators
LEO	Little Environmental Observatory
SEDS	Spatial and Environmental Data Services

1. Introduction

The purpose of this report, 'D4.4 – CITI-SENSE Citizens' Observatories Methodologies Assessment' is to provide assessment results for the selected methodologies in the CITI-SENSE project, from both the methodologies' developers and users perspectives (both internal and external users). As addressed in the section 'Executive Summary,' the methodologies are not the methodologies *per se*, but link the "products" and "services" elements for the chain "sensors-platform-products-users" on the CITI-SENSE Citizens' Observatories. Therefore, the selected methodologies are the project's products and services developed by WPs 6-8, but implemented in WPs 2-3.

This report is a realization of the 'Task 4.3 – Methodology assessment and integration of the project products. The content in this report aligns to Task 4.3 (see the bullet point as described from the DOW) in the following aspects (refer to the explanation after each bullet point):

- by cooperation with WPs 2-3, defining the goal or 'service' of each Empowerment Initiative (EI) integration across cities

  In this report, we selected and assessed 13 major products and services that have been implemented in three EIs. This includes:

  1) Little Environmental Observatory (LEO): For EI on outdoor AQ in cities
  2) CityAir Mobile App: for EI on outdoor AQ in cities
  3) Online Air Quality Perception Questionnaire: for EI on outdoor AQ in cities
  4) Environmental Monitoring Toolkit in Public Spaces: for EI on environmental quality in public spaces
  5) Data visualization Web Portal for Public Spaces Empowerment Initiatives: for EI on environmental quality in public spaces
  6) Data Visualization Web Portal for Outdoor Air Quality: for EI on outdoor AQ in cities
  7) Data Download Web Page: for three EIs
  8) Citizens' Observatories Web Portal: for three EIs
  9) Data Fusion Maps: for EI on outdoor AQ in cities
  10) Static Sensor Pack (AQMesh): for EI on outdoor AQ in cities
  11) Spatial and Environmental Data Services Platform: for three EIs
  12) Obeo radon sensor: for EI on indoor AQ in schools
  13) Atmosphere sensor package: for EI on indoor AQ in schools

- set up an integrated plan that helps identify the required databases and methodologies from each EI

  In CITI-SENSE, the 'Data Download Web Page' was developed to download data from each EI. In this report, we evaluated this 'Data Download Web Page' by the page developers, and both internal and external users.

- by cooperation with WP7-communication platform, provide common access to collected meta-data from each individual EI across cities

  The developed 'Citizens' Observatories Web Portal' is the single point to access to the CITI-SENSE outcome including the meta-database from each EI. In this report, we

evaluated this 'Citizens' Observatories Web Portal' by the portal developers, and both internal and external users.

- analyse data from each individual EI across cities and develop common meta-data information, including definition of data characteristics, format and process data, and assess data usefulness and quality

  This task was performed by WPs 2-3 and partly realized in D2.3 (Bartonova et al., 2015), 2.4 (Cole-Hunter et al., 2016), D3.3 (Aspuru et al., 2015) and D3.4 (Aspuru et al., 2016).

- retrieve and analyse integrated data

  This task has been realized via the products 'Data Download Web Page' and 'Citizens' Observatories Web Portal'. In this report, we assessed both products from the products' developers and users perspective, respectively.

- statistical analysis, data presentation and report results

  This task has been done by WPs 2-3 and partly realized in D2.3 (Bartonova et al., 2015), 2.4 (Cole-Hunter et al., 2016), D3.3 (Aspuru et al., 2015) and D3.4 (Aspuru et al., 2016).

- recommend new actions. In this step, information for action will be derived from prototype results, stakeholder input and mechanisms for access and dissemination. Therefore, visualization tools like maps or interactive computer mapping interface are crucial."

  This task has been realized through the products 'Data Fusion Maps' and 'Citizens' Observatories Web Portal'. In this report, we assessed both products from the products' developers and users' perspective, respectively.

This report comprises five sections. The first section gives a general introduction to this deliverable. Section 2 describes, in detail, what methodologies were developed and implemented by CITI-SENSE Citizens' Observatories (COs). Section 3 describes the methods to assess the CITI-SENSE methodologies. Section 4 presents the methodologies used to assess the results. Finally, section 5 provides a summary and the conclusions of the deliverable.

2. Methodologies Developed and Implemented in the CITI-SENSE Citizens' Observatories

During the CITI-SENSE project period, a catalogue of 13 key methodologies developed by the Consortium and implemented in various COs were chosen to assess its usability. Most were developed by a single partner, however, in some cases joint methodologies were also reported (See Table 2-1).

Table 2-1. CITI-SENSE major methodologies, owners, and categories.

No.	Methodology	Owner (Partner Acronyme)	Category
1	Little Environmental Observatory (LEO)	ATEKNEA	Sensors infrastructures: technological enablers
2	CityAir Mobile App	NILU	Information products and services: application/services
3	Online Air Quality Perception Questionnaire	U-Hopper	Citizens' observatories: methods and theories
4	Environmental Monitoring Toolkit in Public Spaces	Tecnalia	Sensors infrastructures, information products and services, and citizens' observatories
5	Data Visualization Web Portal for Public Spaces Empowerment Initiatives	Dunavnet	Information products and services: application/services
6	Data Visualization Web Portal for Outdoor Air Quality	Dunavnet	Information products and services: application/services
7	Data Download Web Page	Dunavnet	Information products and services: application/services
8	Citizens' Observatories Web Portal (COWP)	NILU	Information products and services: application/services
9	Data Fusion Maps	NILU	Information products and services: application/services
10	AQMesh - Static Sensor Pack	Environmental Instruments llc	Sensors infrastructures: technological enablers
11	Spatial and Environmental Data Services (SEDS) Platform	Snowflake	Data and Services Platforms: Technological Enablers
12	Radon sensor	Obeo	Sensors infrastructures: technological enablers
13	Atmospheric sensors	Alphasense	Sensors infrastructures: technological enablers

For detail description of each methodology, please see D6.4 (Fredriksen et al., 2016), 6.5 (Fredriksen et al., 2016) and D9.15 (Miorandi et al., 2016).

3. Assessing the CITI-SENSE Citizens' Observatories Methodologies

We have developed two methods to evaluate the CITI-SENSE COs methodologies. They include KPIs for methodology assessment (CITI-SENSE consortium assessment) and Indicators for Usability Evaluation (internal and external user assessment). The KPIs aimed to be used by the CITI-SENSE consortium members, especially by those methodologies developers and users who have been interacted in the process of the methodologies development and usage. The Indicators for Usability Evaluation aimed to be used by both internal users and external users who have used the methodologies in practice. These two assessments are complementary and the assessment outputs/outcomes are reflected the usefulness of the methodologies from both the developers and users' perspective.

3.1 KPIs for Methodology Assessment – Self-Assessment

In CITI-SENSE, we developed a set of KPIs to evaluate the project's progress towards its planned objectives including indicators to be used to evaluate the main methodologies. The KPIs were developed by covering CITI-SENSE information flow 'citizens – sensors & platforms – data servers – products & services'. The KPI score was obtained by a questionnaire, and included five completion scales (Table 3-1-1; for detail about KPIs and evaluation methods, please see D4.2 (Citizens' Observatories Strategy, Liu et al., 2014) and D4.3 (CITI-SENSE Citizens' Observatories – Version 1, Liu et al., 2015). The COs methodologies KPIs were developed and self-assessed by the CITI-SENSE consortium, including both methodologies' developers (WPs 4-8) and users (WPs 2-3).

Table 3-1-1. The KPIs evaluation score and completion scale.

Flag colors	Successful level	Score (%)	Completion scale
Blue	Excellent or complete success	90-100	5
Green	Very good or very effective success	80-90	4
Yellow	Good or effective success	70-80	3
Orange	Fair or moderate achievement of goals defined	60-70	2
Red	Low or relatively poor achievement of the objectives defined	<60	1

The KPIs for each methodology included two obligatory questions and optional comments as follows (the numbers under each question are the completion scale that are corresponding with the completion scale listed in Table 3-1-1):

- Q1: To what extend were the project internal stakeholders and users involved in this methodology (i.e., any of these 13 methodologies in Table 3-1-1) development process?

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

- Q2: To what extend was this methodology (i.e., any of these 13 methodologies in Table 3-1-1) performing as expected?

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

- Comments (please write any comments you may have with regarding to this methodology) and your role in the project.

The KPIs for methodologies assessment was implemented in the offline form at CITI-SENSE final meeting in Prague, the Czech Republic, 23-25, August 2016.

3.2 Usability Evaluation for Methodology Assessment – User Assessment

From the methodologies' usability perspective, CITI-SENSE developed a 'usability evaluation form', which aimed to collect users' feedback on a tool or product developed within the CITI-SENSE project. The internal users recruited are those who are involved in WPs 2-3, in practice has tested, and used the products or services in their EIs, e.g., the location officers. The external users recruited are those who have participated in the location-based EIs by using one or several of the products provided by the CITI-SENSE project. These internal and external users are considered being representative of the target users. It needs to be addressed that the different products may have different target users.

The usability assessment form is accessible by this link:

https://docs.google.com/forms/d/e/1FAIpQLSdw5VL8NRTCpV4eMPGE0A95wfKdXHGxaq9McGd6smeoSVyw1g/viewform?c=0&w=1.

The usability assessment form includes the following three sections:

Section 1: questions about users' basic information

1) Gender
2) Year of birth
3) Highest education level
4) In which city did the participant evaluate the tool/product?
5) What is the participant connection to the city in which participant evaluated the tool/products?
6) In general, how interested are participant in air quality?

Section 2: Question about users' feedback about the tool/products friendliness (Please indicate to what extent you agree or disagree to the following statements, 1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree)

7) I would like to use this tool frequently
8) The tool is unnecessary complex
9) The tool was easy to use
10) I need the support of a technical person to be able to use this tool
11) The various functions in this tool were well integrated
12) I thought there were too much inconsistency in this system
13) It easy to learn how to use this tool
14) I felt very confident using the tool
15) I needed to learn a lot of things before I could get going with this tool
16) I have learned something useful by using this tool
17) I would recommend this tool to my friends and family

18) I do not see any reason to use this tool in the future

19) I was satisfied with the tool as a whole

20) I have used this tool many times

Section 3: Questions that users can leave their free comments

21) What aspect of this product has been most useful/satisfying?

22) What aspect of this product has been most disappointing?

The CITI-SENSE usability assessment has been implemented online via the google form: https://docs.google.com/forms/d/135AgqiBKnVGHece0C5IHW1VS9OBywe5cbywmfW9Tgaw/viewform?c=0&w=1, and has been distributed offline at location-based workshops (e.g., Oslo and Ljubljana) and the project meeting in Kjeller, Norway, 15-16, February 2016.

4 Assessment Results

4.1 KPIs Assessment Results – Self Assessment

24 participants from the CITI-SENSE consortium have answered KPIs questionnaires and clarified their role in the project. The KPIs results are presented in Tables 4-1-1 and 4-1-2.

Table 4-1-1. Original – Self-assessment results of the methodologies by KPIs (Methodology No is align with the No. listed in Table 2-1; Q1 = KPIs Question No. 1, Q2 = KPIs Question No. 2 (see Section 3.1); - : no score given from the participant).

Participants No.	Users/developers	Methodology No. and Questions																									
		1		2		3		4		5		6		7		8		9		10		11		12		13	
		Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2
1	**CityAir App Product owner**	2	3	2	4	-	-	4	4	-	-	1	3	2	3	3	4	1	4	-	-	3	3	-	-	-	-
2	**WP4 leader**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	4	-	-	-	-	-	-	-	-	-	
3	**Location officer**	1	-	5	4	5	5	-	-	-	-	4	4	1	-	5	5	4	4	1	-	-	-	1	-	1	1
4	**WP5 participant**	-	-	-	-	2	4	4	-	-	-	-	-	-	-	3	-	-	4	-	-	-	-	-	-	-	
5	**Project facilitator**	1	2	3	4	1	5	2	4	2	5	4	3	3	3	2	5	1	5	5	4	-	-	2	-	3	2
6	**Platform developer**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3
7	**Location officer**	2	1	4	4	4	5	-	-	-	-	3	2	3	2	4	3	4	4	3	3	-	-	-	-	-	
8	**Project officer**	1	2	-	-	-	-	-	-	-	-	1	2	1	4	-	-	1	4	1	2	1	-	-	-	-	-

9	**Technical advisory member**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10	**WP8 leader**	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1	3	1	5	1	3	1	3
11	**consortium partner**	1	1	2	3	2	-	2	-	3	-	1	1	-	-	1	1	-	-	-	-	-	-	-	-	1	1
12	**Local organizer**	4	3	3	3	4	3	3	3	2	-	2	2	2	3	2	2	1	1	2	1	1	1	1	1	2	1
13	**WP9 leader**	-	2	-	1	-	-	-	2	-	-	-	2	-	-	1	2	-	3	-	-	-	-	-	-	-	-
14	**-**	1	3	1	4	2	2	1	4	-	-	1	2	2	3	2	4	1	4	1	4	-	-	-	-	-	
15	**WP2 Location officer**	1	1	1	1	1	2	-	-	-	-	-	-	1	2	2	3	3	4	1	4	1	2	-	-	-	
16	**WP6 Data fusion leader**	-	-	-	4	-	-	-	-	-	-	-	3	-	-	-	3	1	3	1	3	3	5	-	-	-	-
17	**Project manager, Oslo cast study assistant**	1	2	2	4	1	4	-	-	-	-	1	3	-	-	1	2	1	2	1	2	-	-	1	-	1	-
18	**WP2 location officer**	1	1	3	3	5	5	-	-	-	-	1	2	1	1	-	-	1	4	3	2	-	-	-	-	-	-
19	**Technology Developer**	3	2	3	3	4	3	3	3	4	-	3	3	4	2	3	3	4	4	3	2	2	2	3	2	3	2
20	**WP3b lead**	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	1	-	-	-	-	-	-	1	1	1	2
21	**WP3b Oslo case study participant**	-	-	-	3	-	-	-	4	-	-	2	2	4	4	-	4	-	-	-	-	-	-	3	3	1	3

22	**Location officer**	2	3	2	4	2	4	-	-	-	-	2	4	2	4	2	3	1	4	1	4	1	-	1	4	2	3
23	**Sensor supplier**	2	3	3	3	2	2	3	3	2	-	3	3	3	3	3	3	2	2	4	4	2	2	1	1	5	5
24	**WP7 lead**	4	4	4	4	4	4	4	3	3	-	4	3	4	4	4	4	3	4	3	3	4	3	4	4	3	3

Table 4-1-2. Summarized results of the methodologies assessment by KPIs.

Methodology No.	Methodology	Evaluation results						
		Completion scale		Evaluation score (%)		Flag color		Successful level
		Q1	Q2	Q1	Q2	Q1	Q2	
1	**Little Environmental Observatory (LEO)**	2	2	60-70	60-70			Fair or moderate achievement of goals defined
2	**CityAir Mobile App**	3	3	70-80	70-80			Good or effective success
3	**Online Air Quality Perception Questionnaire**	3	4	70-80	80-90			Good or quite effective success
4	**Environmental Monitoring Toolkit in Public Spaces**	3	3	70-80	70-80			Good or effective success
5	**Data visualization Web Portal for Public Spaces Empowerment Initiatives**	3	5	70-80	90-100			Very good or very effective success
6	**Data Visualization Web Portal for Outdoor Air Quality**	2	3	60-70	70-80			Moderate or quite effective success
7	**Data Download Web Page**	2	3	60-70	70-80			Moderate or quite effective success
8	**Citizens' Observatories Web Portal**	2	3	60-70	70-80			Moderate or quite effective success
9	**Data Fusion Maps**	2	4	60-70	80-90			Good or effective success
10	**Static Sensor Pack (AQMesh)**	2	3	60-70	70-80			Moderate or quite effective success
11	**Spatial and Environmental Data Services (SEDS) Platform**	2	3	60-70	70-80			Moderate or quite effective success
12	**Obeo radon sensor**	2	2	60-70	60-70			Fair or moderate achievement of goals defined
13	**Atmospheric sensor package**	2	1	60-70	<60			Fair or relatively low achievement of the objectives defined

From the Tables 4-1-1 and 4-1-2, based upon the evaluation by the methodology developers and internal users for sensors and sensor platforms, we can see that (i) three types of sensors (LEO, Obeo radon sensor and Atmospheric sensor package) got relatively low scores with fair or relatively low achievement; (ii) static sensor pack – AQMesh has reached moderate or quite effective success;

(iii) Environmental Monitoring Toolkit in Public Spaces reached good or effective success; and (iv) SEDS platform has reached moderate or quite effective success. For Air Quality Perception Surveys, we can see that both CityAir App and Online Air Quality Perception Questionnaire has achieved good or quite effective success. For Data Visualization Web Portals and Data Download Web Pages, we can see that (i) Data visualization Web Portal for Public Spaces Empowerment Initiatives achieved very good or very effective success; and (ii) Data Visualization Web Portal for Outdoor Air Quality and Data Download Web Page has moderate or quite effective success. For integrated outcome of the project, we can see that (i) Citizens' Observatories Web Portal has reached moderate or quite effective success; and (ii) Data Fusion Maps reached good or effective success.

In the KPIs assessments, there were not many comments made by the CITI-SENSE consortium members. However, the project participants in the COs for Indoor Air Quality in Schools addressed the fact that they were not interested in the web-pages (i.e., http://schools.citi-sense.eu/), but only interested in getting easy access to data from the sensors to be used for their science projects. The data downloading application was very slow and not suitable for downloading of large amounts of data. Further, several of the consortium members addressed the issue that the project internal users and stakeholders had been involved into the development of all of the 13 listed methodologies, but only the CityAir App and the AQMesh involved both internal and external stakeholders and users at some point in their development processes.

For external users' feedback on seven methodologies by using the indicators from the CITI-SENSE Usability Evaluation Form (Table 4-2-1), please see Section 4.2. For the report on the performance of the methodologies based on feedback from the Ljubljana case study where they have collected feedback also based on interview and plenary sessions with end users, please see D6.5 (Report on implementation and demonstration, Fredriksen et al., 2016). For the report on the evaluation of empowerment initiatives based upon interview with the focus groups including both methodologies' internal users (project location officers) and external users (recruited participants), please see D5.5 (Co-ordinated analysis and evaluation of empowerment initiatives, Keune et al., 2016).

4.2 Usability Evaluation Results – User Assessment

We have engaged both consortium members and external users to evaluate seven of the 13 selected methodologies (Table 4-2-1) via the usability evaluation form, including both an online and offline approach, as well as using different languages (i.e., English, Norwegian, and Slovene). The detailed results for individual methodologies are presented in the following Sections 4-2-1 – 4-2-13, respectively.

Table 4-2-1. Overview of the total participants' number who evaluated the methodologies by using the usability evaluation form (The methodology No. is align with the No. listed in Table 2-1 and Table 4-1-2).

Methodology No.	Methodology	Participants using the English language online form	Participants using the English language offline form	Participants using Norwegian language form	Participants using Slovene language form	Total number of participants
1	**Little Environmental Observatory (LEO)**	10	26	25	11	72
2	**CityAir Mobile App**	17	8	13	5	43

3	**Online Air Quality Perception Questionnaire**	1	11	0	0	12
4	**Environmental Monitoring Toolkit in Public Spaces**	0	8	0	0	8
6	**Data Visualization Web Portal for Outdoor Air Quality**	7	6	0	3	16
7	**Data Download Web Page**	1	0	0	0	1
8	**Citizens' Observatories Web Portal**	2	10	0	0	12

4.2.1 Little Environmental Observatory

72 participants evaluated the LEO by using the usability evaluation form. The results are presented in Figure 4-2-1-1 and Table 4-2-1-1.

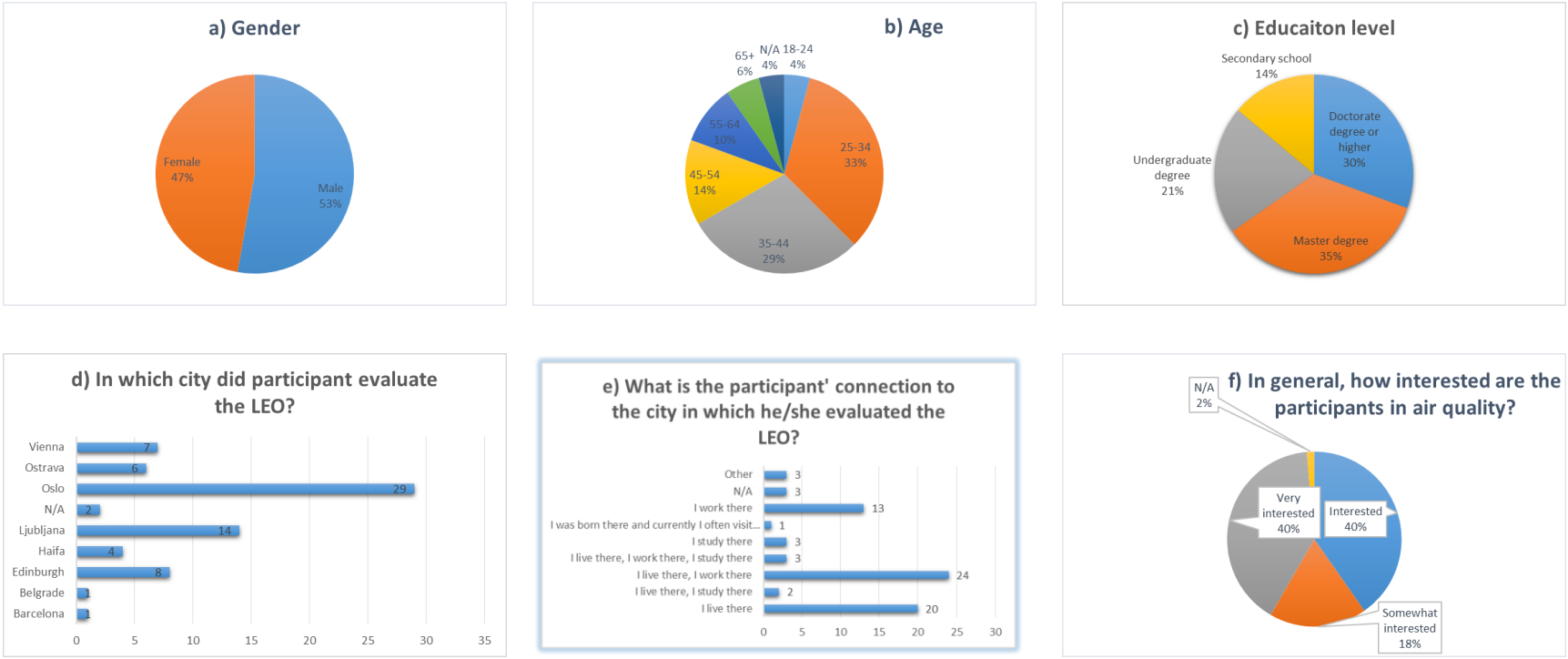
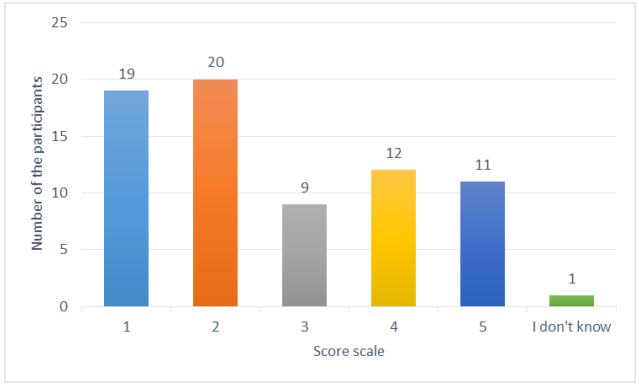
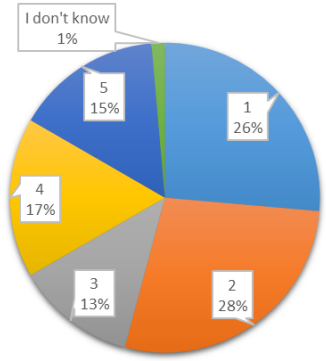
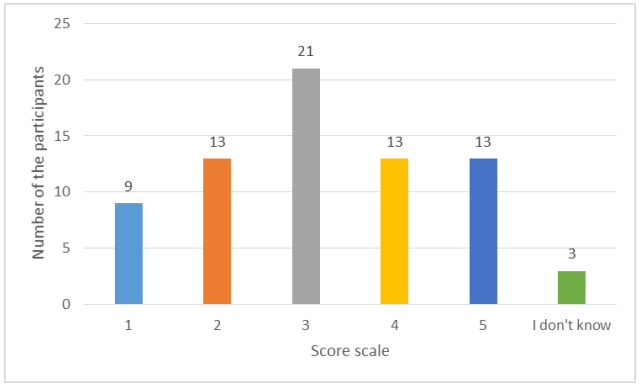
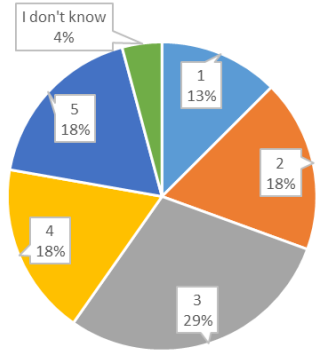
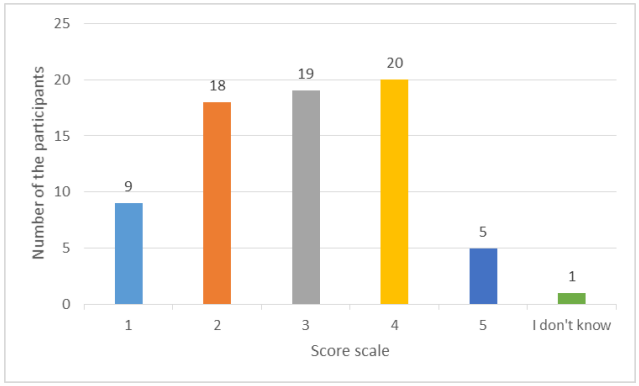


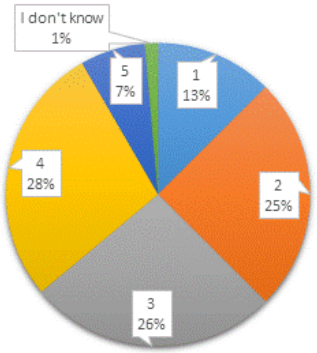
Figure 4-2-1-1. Little Environmental Observatory usability evaluation – users' basic information (N/A: not answered).

Table 4-2-1-1. Little Environmental Observatory usability evaluation – users' feedback – quantified (1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree; % = Number in percentage of participants that gave scores between 1 and 5).

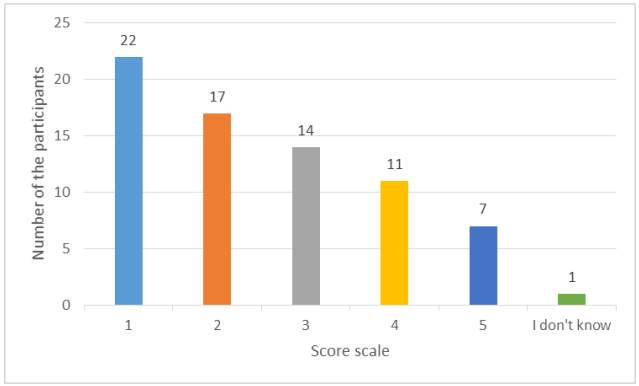
Question No.	Usability questions	Results	
1	I would like to use this tool frequently		
2	The tool unnecessary complex		

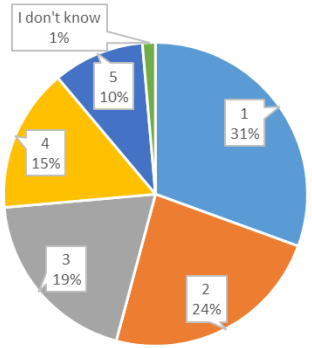
3 **The tool was easy to use**



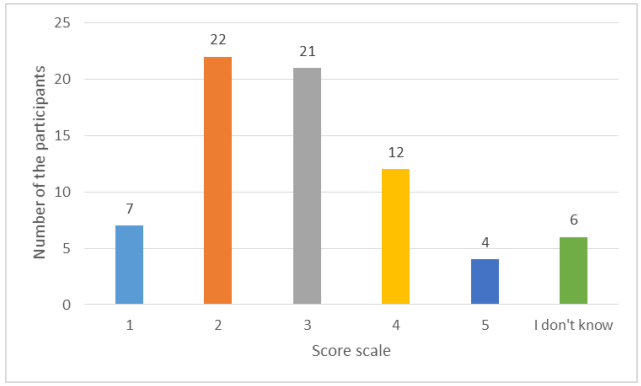


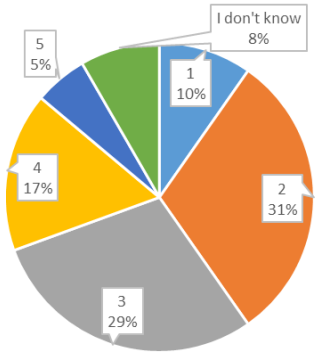
4 **I need the support of a technical person to be able to use this tool**



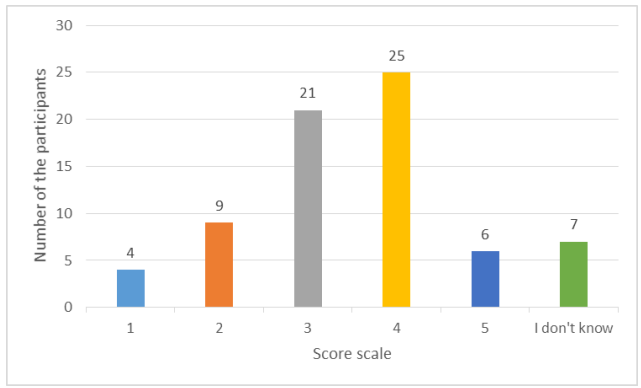


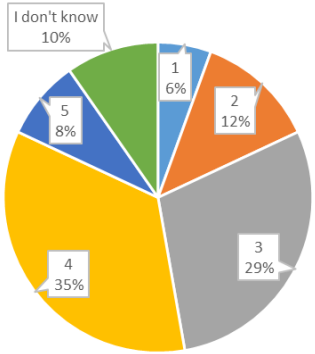
5 **The various functions in this tool were well integrated**



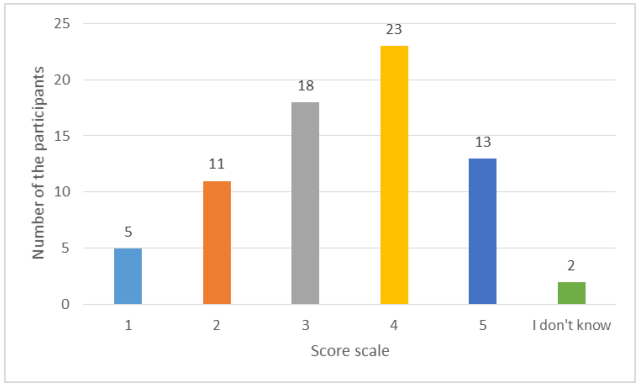


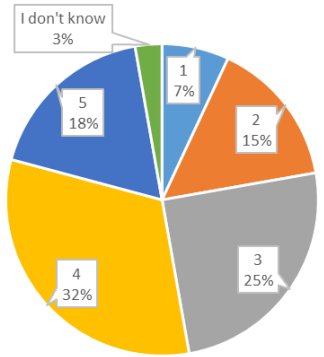
6 **I thought there were too much inconsistency in this system**



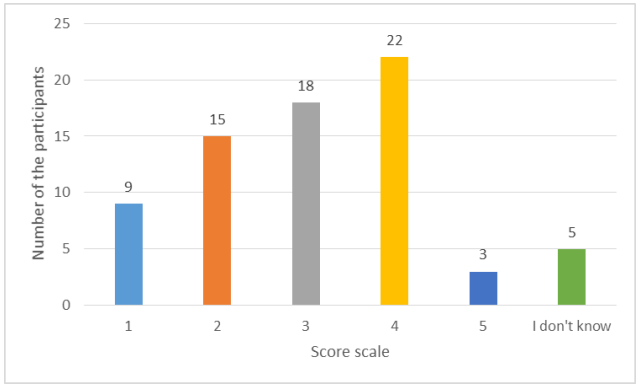


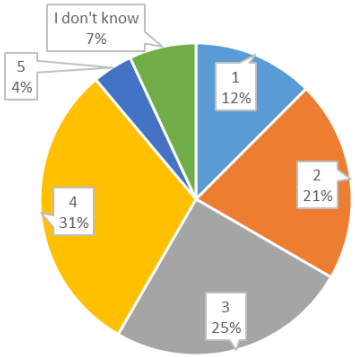
7 **It easy to learn how to use this tool**



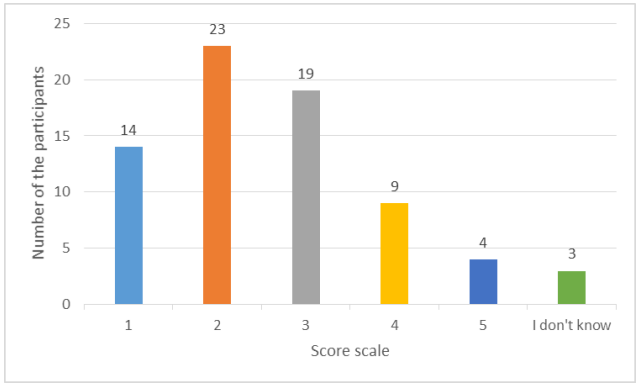


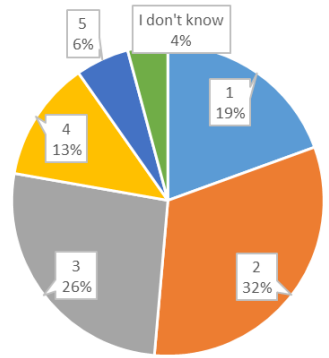
8 **I felt very confident using the tool**



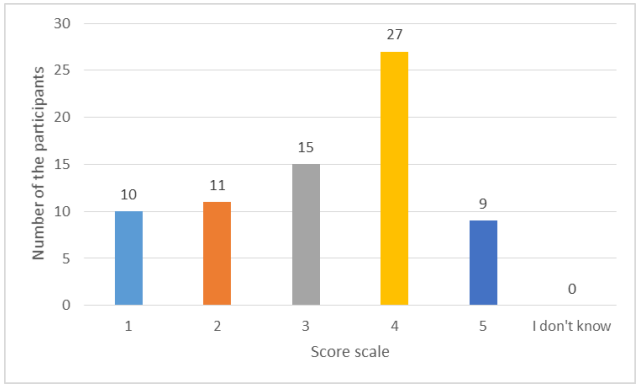


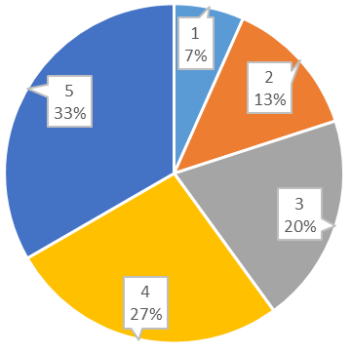
9 **I needed to learn a lot of things before I could get going with this tool**



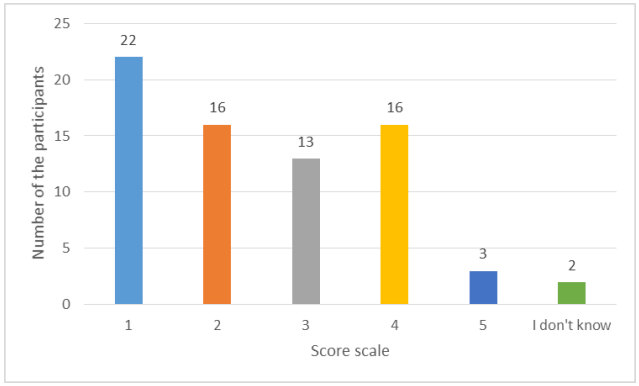


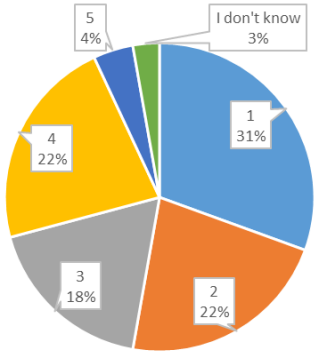
10 **I have learned something useful by using this tool**



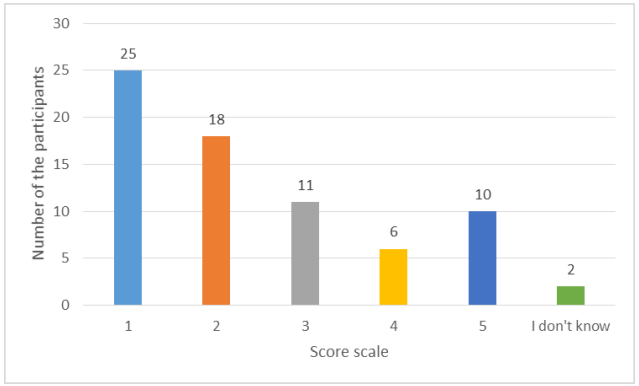


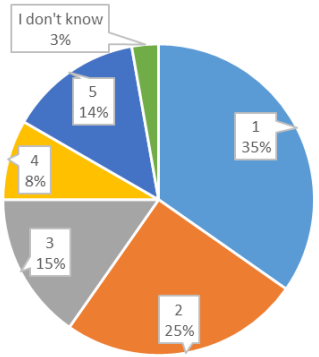
11 **I would recommend this tool to my friends and family**



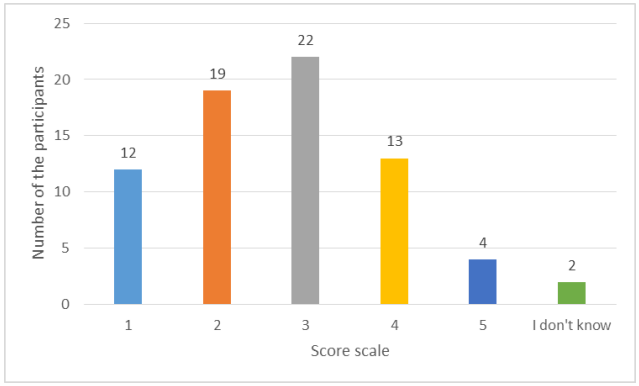


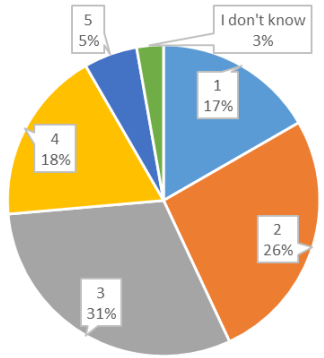
12 **I do not see any reason to use this tool in the future**



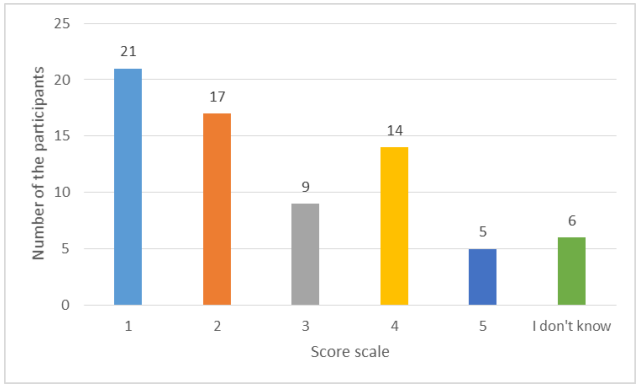


13 **I was satisfied with the tool as a whole**





14 **I have used this tool many times**



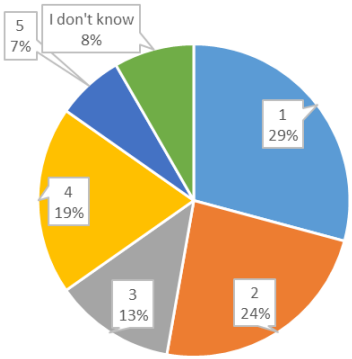


Figure 4-2-1-1shows the demographics for answers regarding LEO. Out of 72 participants (i) 47% are female; (ii) 33% of the participants are in the age between 25-34, and 29% between 35-44, (iii) most participants (65%) are highly educated either with master degree (35%) or Ph.D degree (30%), (iv) most participants – 29 - are from Oslo. 80% of the participants expressed that they are interested in or very interested in air quality related issues in general, and 18% expressed that they are somewhat interested in air quality issues.

With regard to the users' feedback on the LEO's user friendliness, we can see from Table 4-2-1-1, that out of 72 participants: (i) 32% (15% + 13%) of the participants expressed that they would like to use the LEO frequently, 54% (26%+28%) showed they would not use the LEO frequently, 13% showed their intermediate point of view on it and 1% did not know if they would like to use the LEO frequently or not; (ii) 31% (13%+18%) of the participants thought the LEO is quite simple, 36% (18%+18%) thought the LEO is unnecessary complex, 29% did express their intermediate point of view on it and 4% did not know if the LEO is unnecessary complex or not; (iii) 35% (28%+7%) of the participants thought the LEO is easy to use, 38% (13%+25%) thought the LEO is not easy to use, 26% did express their intermediate point of view on it and 1% did not know if the LEO is easy to use or not; (iv) 25% (15%+10%) of the participants indicated that they need the support of a technical person to be able to use the LEO, 55% (31%+24%) of the participants indicated that they can use the LEO without the support from a technical person, 19% did indicate their intermediate point of view on it and 1% did not know if they need the technical support or not to be able to use the LEO; (v) 22% (17%+5%) of the participants thought the various function in the LEO were well integrated, 41% (10%+31%) thought the various function in the LEO were not well integrated, 20% did indicate their intermediate point of view on it and 8% did not know if the various functions in the LEO were well integrated or not; (vi) 43% (35%+8%) of the participants thought that there were too much inconsistency in the LEO, 18% (6%+12%) thought there were not too much inconsistency in the LEO, 29% indicated their intermediate point of view on it and 10% did not know if there were too much inconsistency in the LEO or not; (vii) 50% (32%+18%) of the participants indicated that it is easy to learn how to use the LEO, 22% (7%+15%) thought it is not easy to learn how to use the LEO, 25% did indicate their intermediate point of view on it and 3% did not know if it is easy to learn to use the LEO or not; (viii) 35% (31%+4%) of the participants felt very confident using the LEO, 33% (12%+21%) felt not very confident using the LEO, 25% indicated their intermediate point of view on it, and 7% did not know if they felt very confident using the LEO or not; (ix) 19% (13%+6%) of the participants needed to learn a lot of things before they could get going with the LEO, 51% (19%+32%) did not need to learn a lot of things before they could get going with the LEO, 26% indicated their intermediate point of view on it and 4% did not know if they need to learn a lot of things before they could get going with the LEO or not; (x) 60% (27%+33%) of the participants have learned something useful by using the LEO, 20% (7%+13%) indicated that they have not learned things useful by using the LEO, and 20% indicated their intermediate point of view on it; (xi) 26% (22%+4%) of the participants would like to recommend the LEO to their friends and family, 53% (31%+22%) would not recommend the LEO to their friends and family, 18% indicated their intermediate point of view on it and 3% did not know if they would recommend the LEO to their friends and family or not; (xii) 22% (8%+14%) of the participants did not see any reason to use the LEO in the future, 60% (35%+25%) did see the potentials to use the LEO in the future, 15% indicated their intermediate point of view on it and 3% did not know if they want to use the LEO in the future or not; (xiii) 23% (18%+5%) of the participants were satisfied with the LEO as a whole, 43% (17%+26%) were not satisfied with the LEO as a whole, 31% did indicate their intermediate point of view on it and 3% did not know if they were satisfied or not with the LEO as a whole; (xiv) 26% (19%+7%) of the participants have used the LEO many times, 53% (29%+24%) have not used the LEO many times, 13% indicated their intermediate point of view on it and 8% did not know if they have used the LEO tool many times or not.

4.2.2 CityAir Mobile App

43 participants evaluated the CityAir App by using the usability assessment form. The results are presented in Figure 4-2-2-1. Table 4-2-2-1, Table 4-2-2-2.

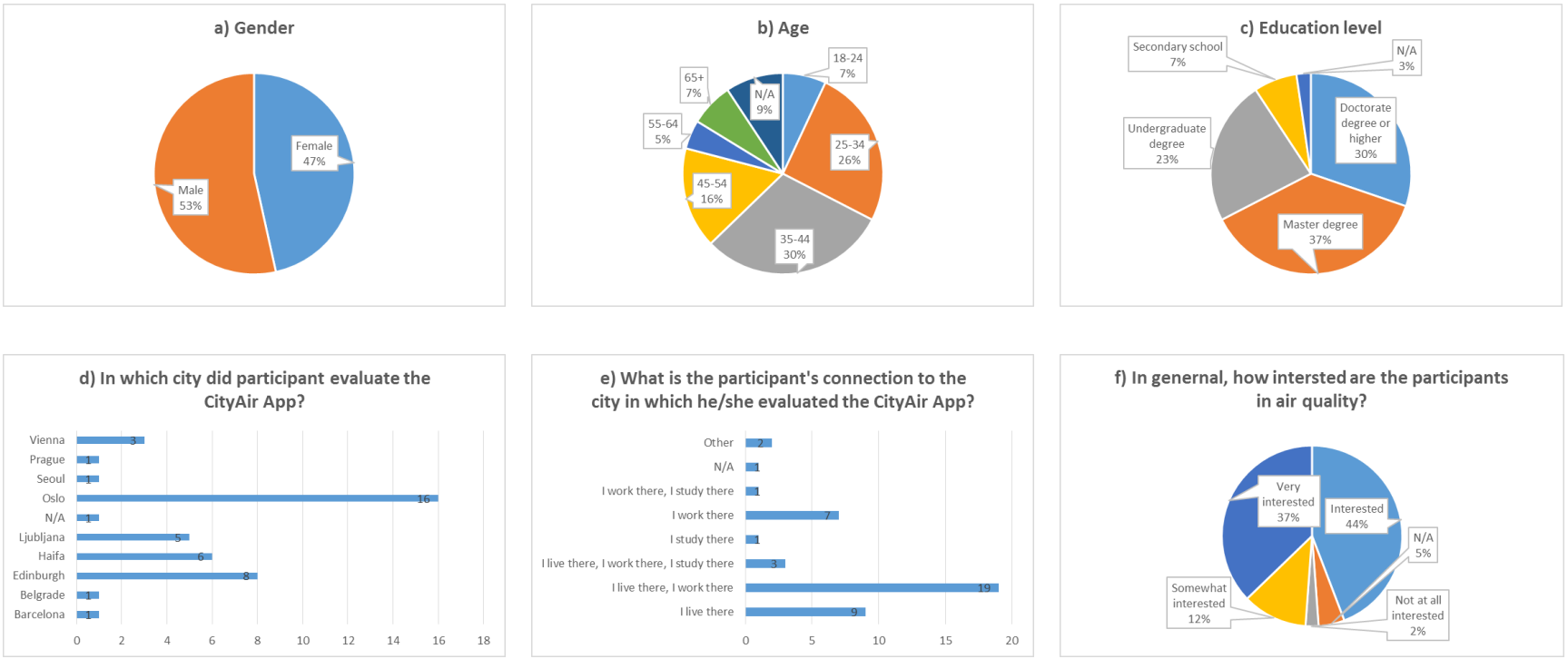
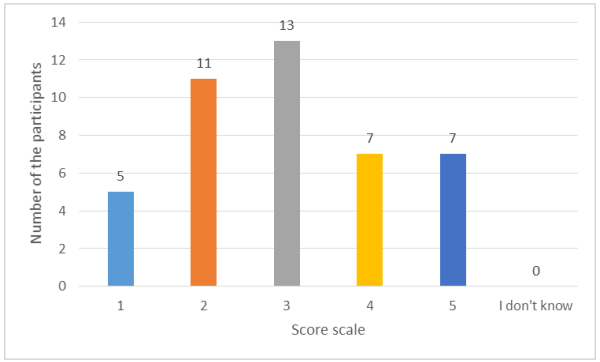
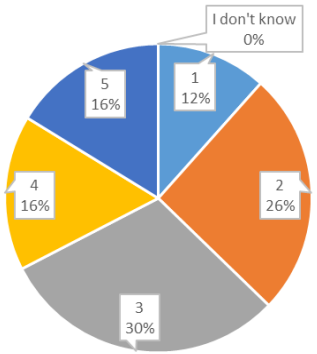
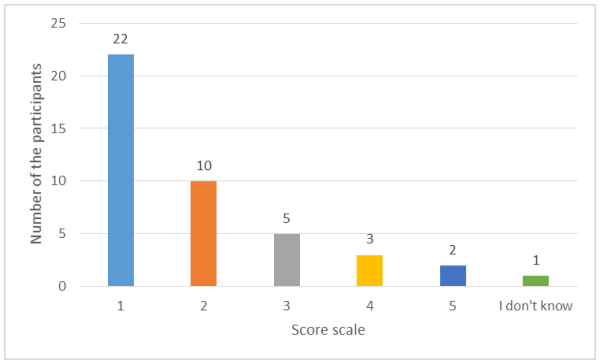
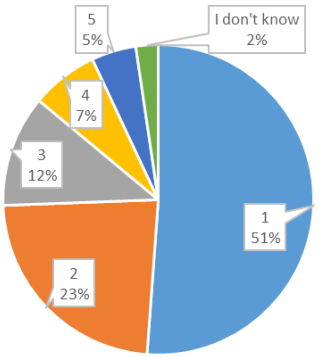
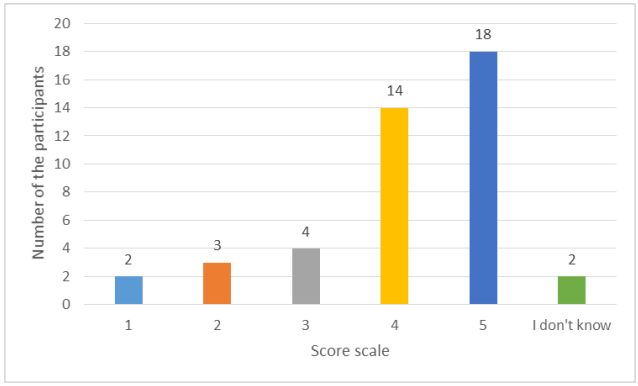


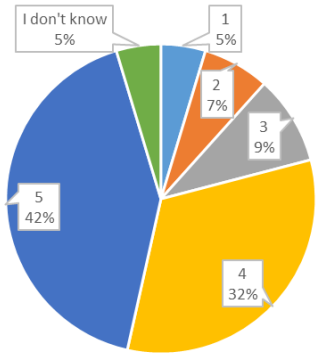
Figure 4-2-2-1. CityAir App usability evaluation – users' basic information (N/A: not answered).

Table 4-2-2-1. CityAir Mobile App usability evaluation – users' feedback – quantified (1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree; N/A: not answered).

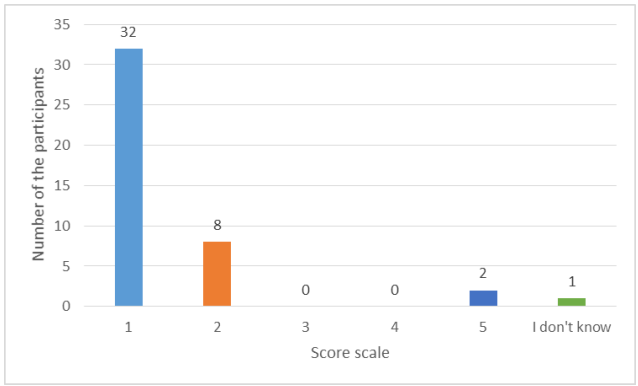
Question No.	Usability questions	Results
1	I would like to use this tool frequently	 
2	The tool unnecessary complex	 

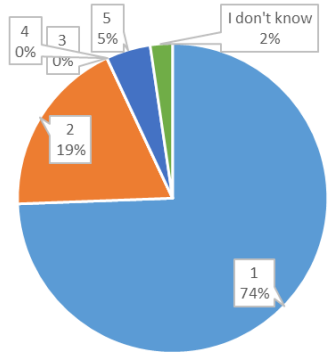
3 **The tool was easy to use**



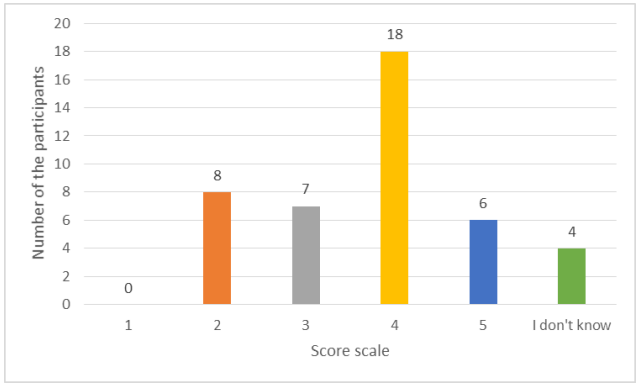


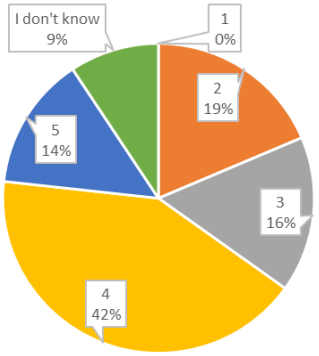
4 **I need the support of a technical person to be able to use this tool**



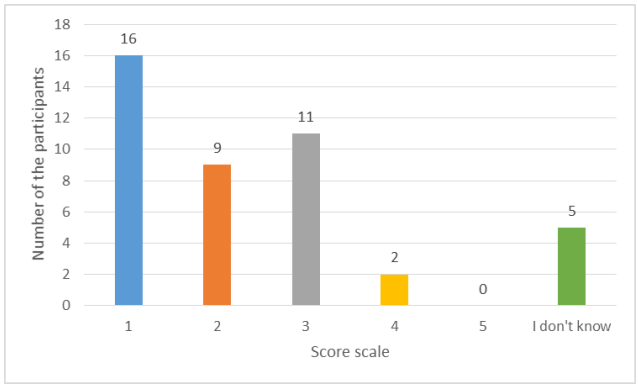


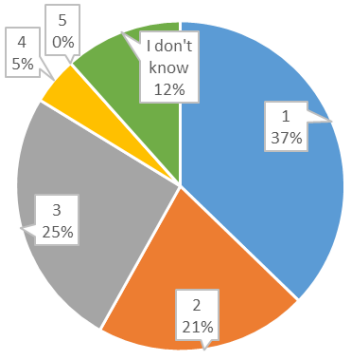
5 **The various functions in this tool were well integrated**



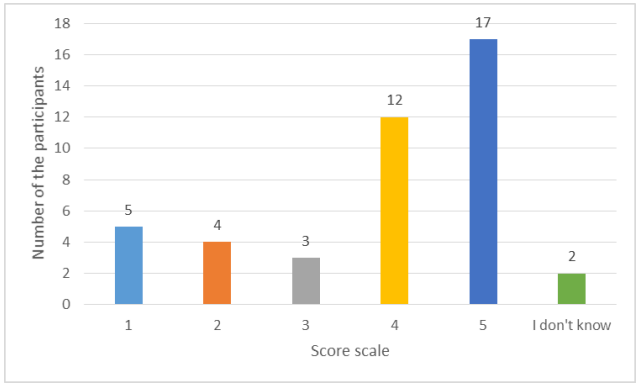


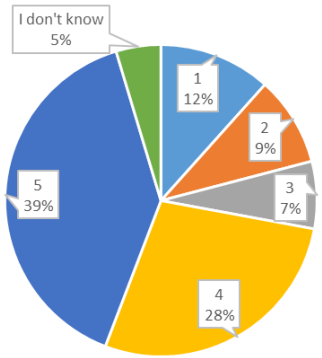
6 **I thought there were too much inconsistency in this system**



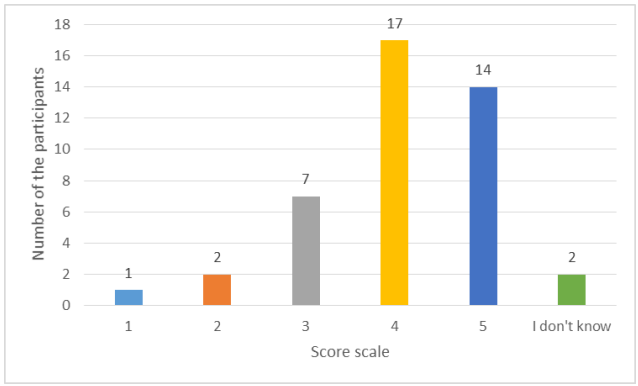


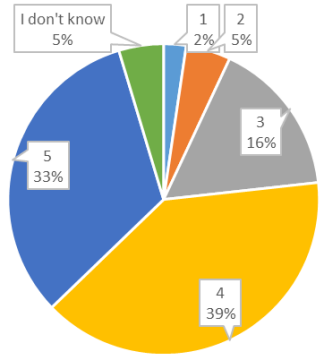
7 **It easy to learn how to use this tool**



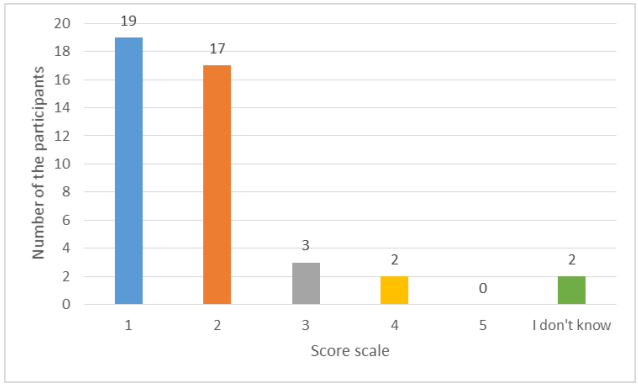


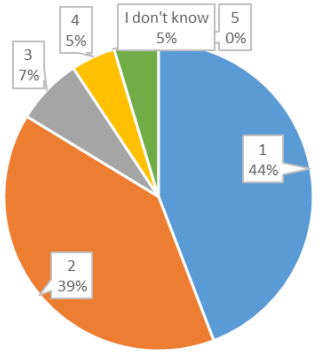
8 **I felt very confident using the tool**



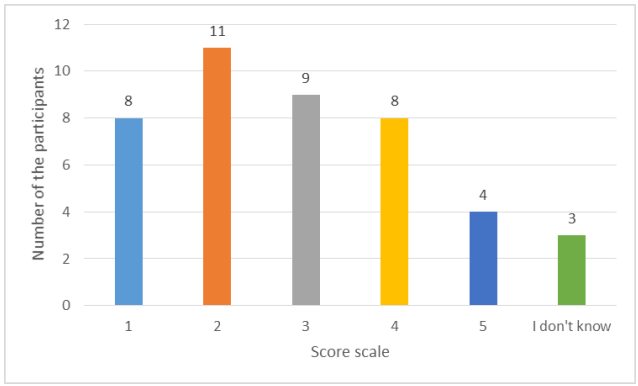


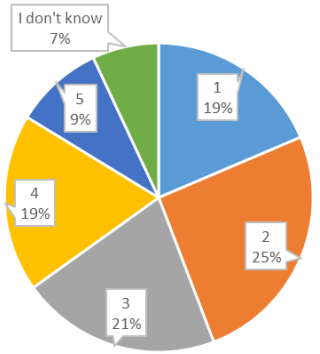
9 **I needed to learn a lot of things before I could get going with this tool**



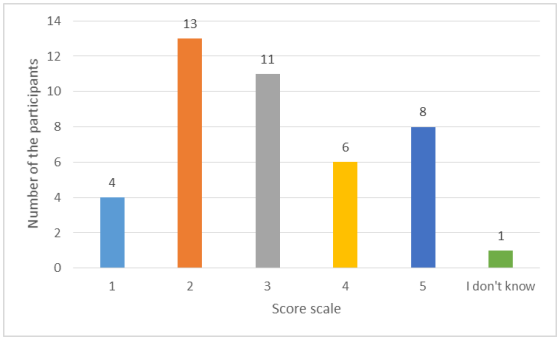


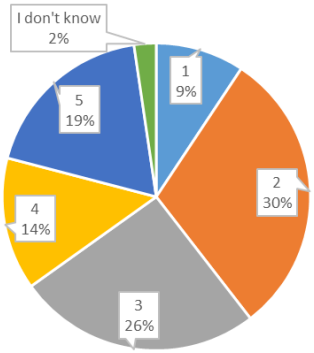
10 **I have learned something useful by using this tool**



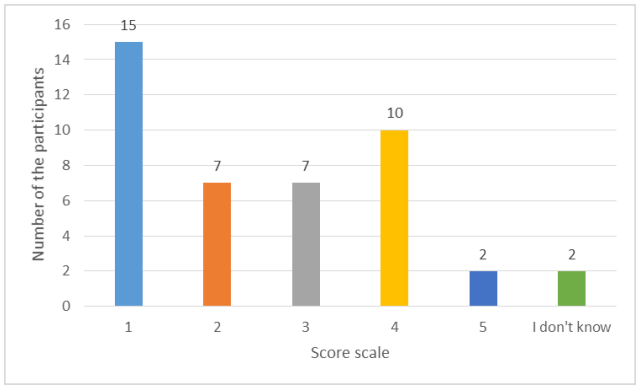


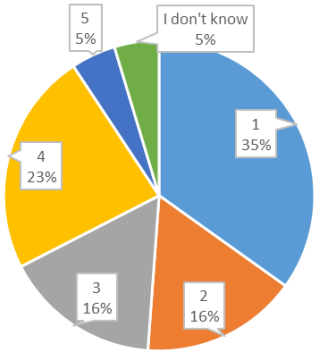
11 **I would recommend this tool to my friends and family**



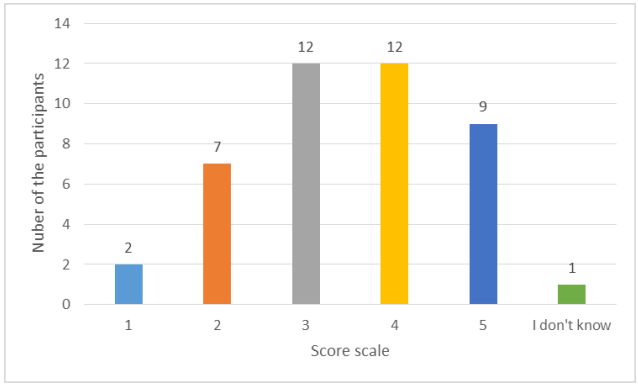


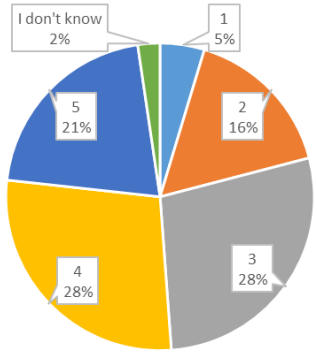
12 **I do not see any reason to use this tool in the future**



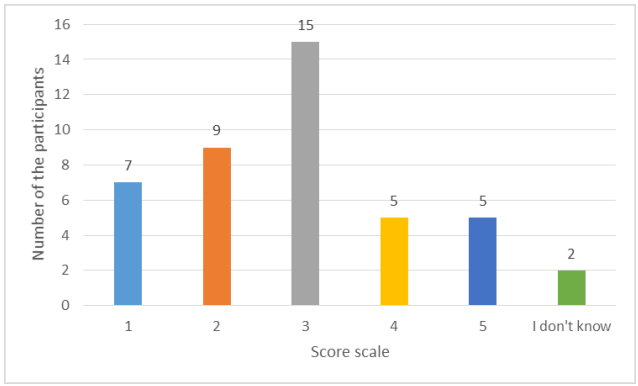


13 **I was satisfied with the tool as a whole**





14 **I have used this tool many times**



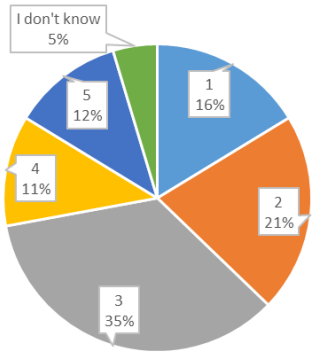


Figure 4-2-2-1 details the results for the at we can see that out of 43 participants: (i) 53% are male and 47% are female; (ii) 30% of the participants are in the age between 35-45, 26% between 25-34, 16% between 45-54, 7% between 18-24, 7% above 65, 5% between 55-64 and 9% did not specific which age group they belong to; (iii) most participants (67%) are highly educated either with master degree (37%) or Ph.D degree (30%), 23% of the participants have bachelor degree, 7% a secondary school and 3% did not answer what education level they have; (iv) 16 participants are from Oslo, followed with Edinburgh (8), Haifa (6), Ljubljana (5), Vienna (3), Barcelona (1), Belgrade (1), Prague (1), Seoul (1) and one participant did not answer in which city he/she did evaluate the CityAir App; (v) most of the participants (35) either live (9) or work (7) or both live and work (19) in the city where they evaluated the CityAir App, other participants are either studying there (5) or did not answer (1) or chose other ways (2) of connection to the city where they evaluated the CityAir App; (vi) 81% of the participants expressed that they are interested in (44%) or very interested in (37%) air quality related issues in general, 12% expressed that they are somewhat interested in air quality issues; 2% are not at all interested in air quality issues, and 5% did not answer.

With regard to the users' feedback on the CityAir App's user friendliness, we can see from Table 4-2-2-1, that out of 43 participants: (i) 32% (16% + 16%) of the participants expressed that they would like to use the CityAir App frequently, 38% (12%+26%) showed they would not use the CityAir App frequently, 30% showed their intermediate point of view on it; (ii) 74% (51%+23%) of the participants thought the CityAir App is quite simple, 12% (7%+5%) thought the CityAir App is unnecessary complex, 12% did express their intermediate point of view on it and 2% did not know if the CityAir App is unnecessary complex or not; (iii) 74% (32%+42%) of the participants thought the CityAir App is easy to use, 12% (5%+7%) thought the CityAir App is not easy to use, 9% did express their intermediate point of view on it and 5% did not know if the CityAir App is easy to use or not; (iv) 5% (5%+0%) of the participants indicated that they need the support of a technical person to be able to use the CityAir App, 93% (74%+19%) of the participants indicated that they can use the CityAir App without the support from a technical person, and 2% did not know if they need the technical support or not to be able to use the CityAir App; (v) 56% (42%+14%) of the participants thought the various function in the CityAir App were well integrated, 19% (0%+19%) thought the various function in the CityAir App were not well integrated, 16% did indicate their intermediate point of view on it and 9% did not know if the various functions in the CityAir App were well integrated or not; (vi) 5% (5%+0%) of the participants thought that there were too much inconsistency in the CityAir App, 58% (37%+21%) thought there were not too much inconsistency in the CityAir App, 25% indicated their intermediate point of view on it and 12% did not know if there were too much inconsistency in the CityAir App or not; (vii) 67% (28%+39%) of the participants indicated that it is easy to learn how to use the CityAir App, 21% (12%+9%) thought it is not easy to learn how to use the CityAir App, 7% did indicate their intermediate point of view on it and 5% did not know if it is easy to learn to use the CityAir App or not; (viii) 72% (33%+39%) of the participants felt very confident using the CityAir App, 7% (2%+5%) felt not very confident using the CityAir App, 16% indicated their intermediate point of view on it, and 5% did not know if they felt very confident using the CityAir App or not; (ix) 5% (5%+0%) of the participants needed to learn a lot of things before they could get going with the CityAir App, 83% (44%+39%) did not need to learn a lot of things before they could get going with the CityAir App, 7% indicated their intermediate point of view on it and 5% did not know if they need to learn a lot of things before they could get going with the CityAir App or not; (x) 28% (19%+9%) of the participants have learned something useful by using the CityAir App, 44% (19%+25%) indicated that they have not learned things useful by using the CityAir App, 21% indicated their intermediate point of view on it, and 7% did not know if they have learned something useful by using the CityAir App or not ; (xi) 33% (14%+19%) of the participants would like to recommend the CityAir App to their friends and family, 39% (9%+30%) would not recommend the CityAir App to their friends and family, 26% indicated their intermediate

point of view on it and 2% did not know if they would recommend the CityAir App to their friends and family or not; (xii) 39% (16%+23%) of the participants did not see any reason to use the CityAir App in the future, 51% (35%+16%) did see the potentials to use the CityAir App in the future, 16% indicated their intermediate point of view on it and 5% did not know if they want to use the CityAir App in the future or not; (xiii) 49% (28%+21%) of the participants were satisfied with the CityAir App as a whole, 21% (5%+16%) were not satisfied with the CityAir App as a whole, 28% did indicate their intermediate point of view on it and 2% did not know if they were satisfied or not with the CityAir App as a whole; (xiv) 23% (11%+12%) of the participants have used the CityAir App many times, 37% (16%+21%) have not used the CityAir App many times, 35% indicated their intermediate point of view on it and 5% did not know if they have used the CityAir App many times or not.

4.2.3 Online Air Quality Perception Questionnaire

12 participants evaluated the online air quality perception questionnaire, and the results are presented in Figure 4-2-3-1, Tables 4-2-3-1 and 4-2-3-2.

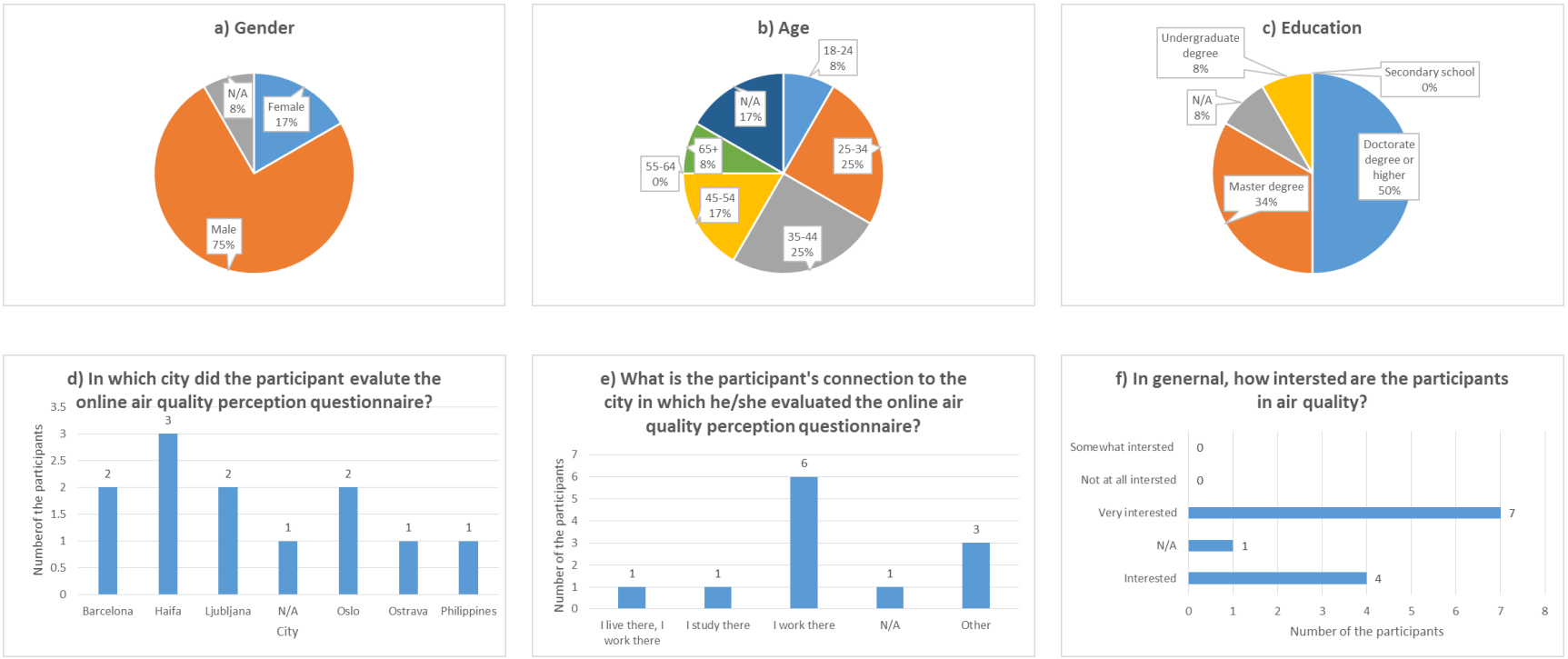
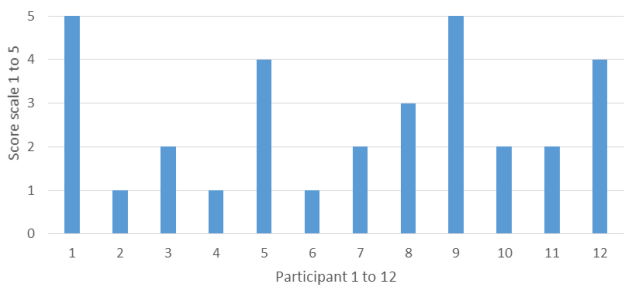
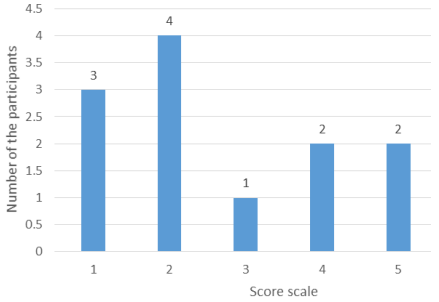
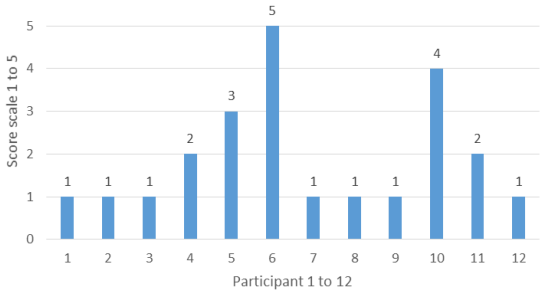
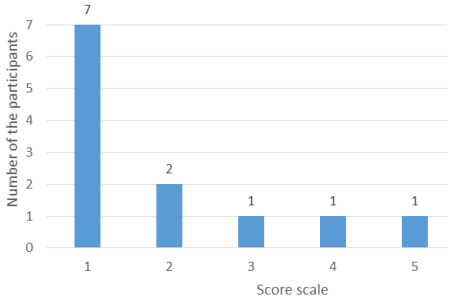
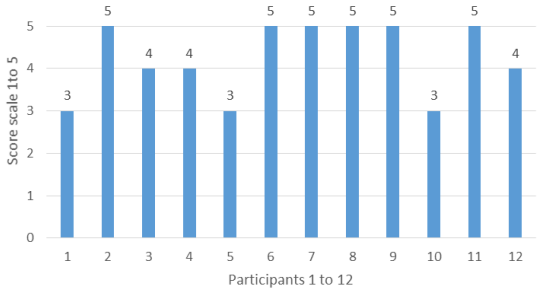
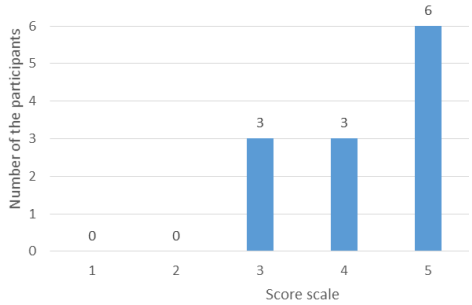
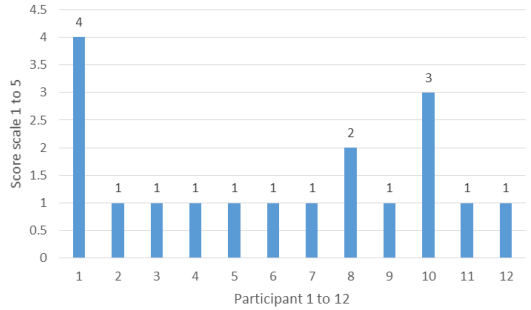


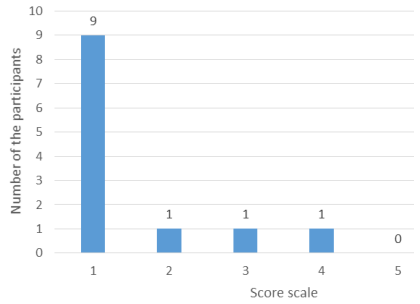
Figure 4-2-3-1. Online Air Quality Perception Questionnaire usability evaluation – users' basic information (N/A: not answered).

Table 4-2-3-1. Online Air Quality Perception Questionnaire usability assessment – users' feedback – quantified (1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree; N/A: not answered).

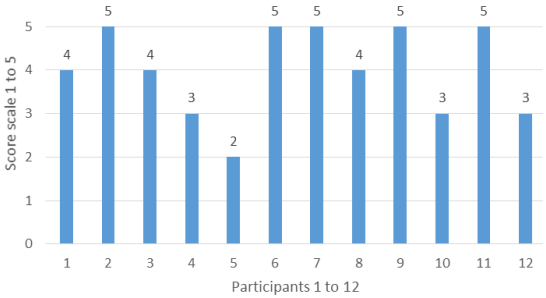
Question No.	Usability questions	Results	
1	I would like to use this tool frequently		
2	The tool unnecessary complex		
3	The tool was easy to use		

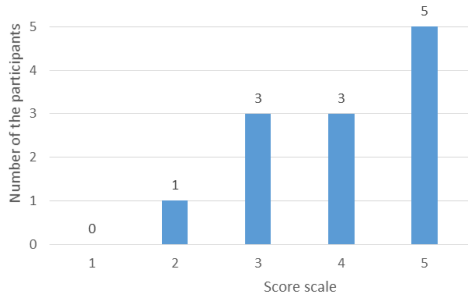
4 **I need the support of a technical person to be able to use this tool**



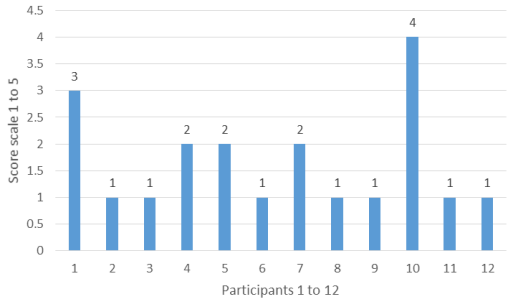


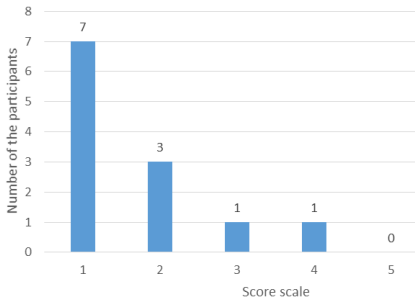
5 **The various functions in this tool were well integrated**



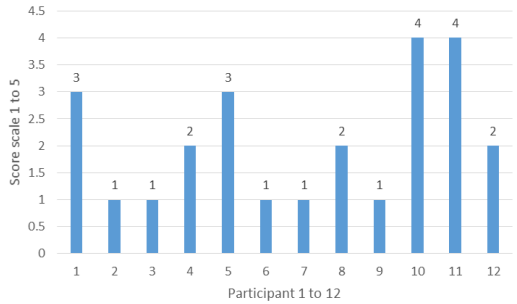


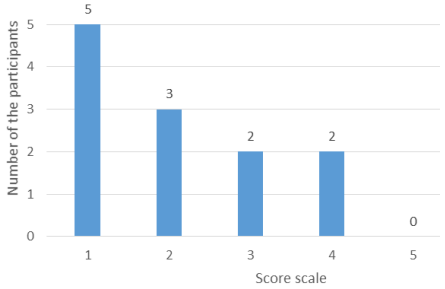
6 **I thought there were too much inconsistency in this system**



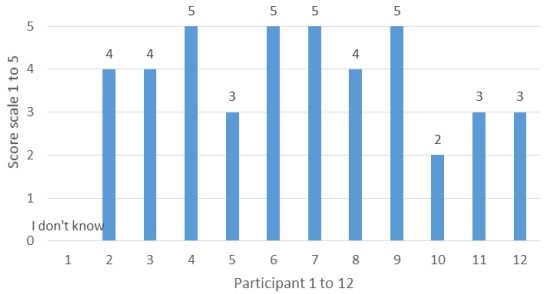


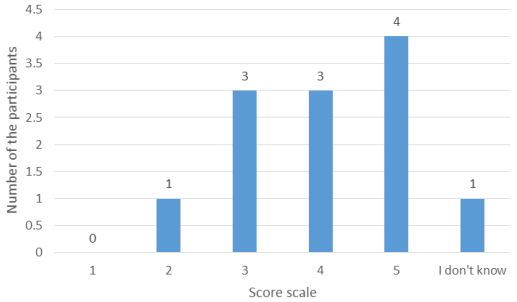
7 **It easy to learn how to use this tool**



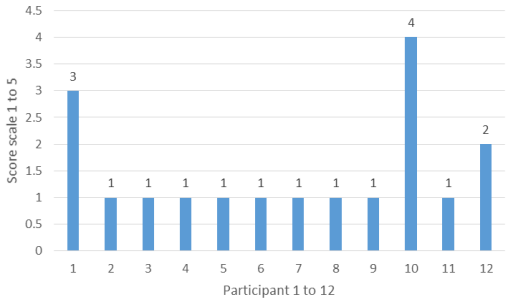


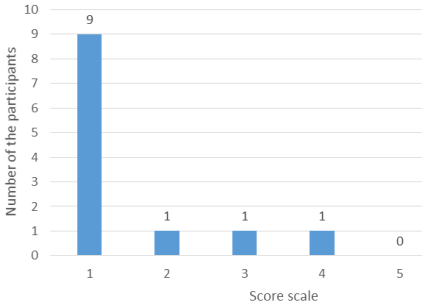
8 **I felt very confident using the tool**



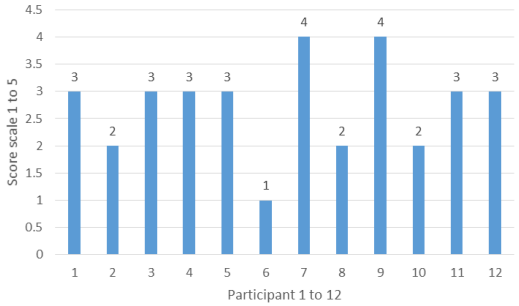


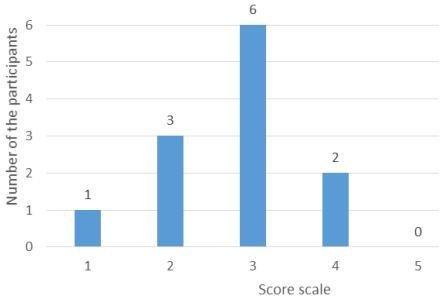
9 **I needed to learn a lot of things before I could get going with this tool**



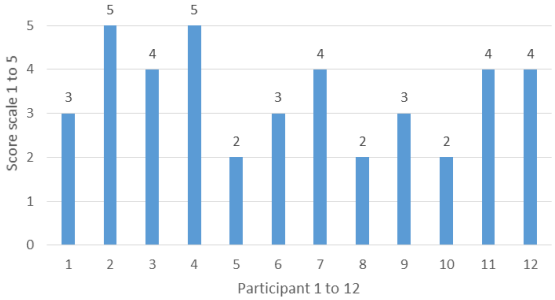


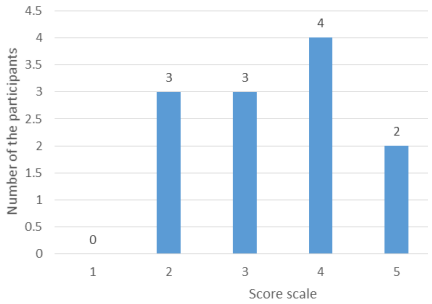
10 **I have learned something useful by using this tool**



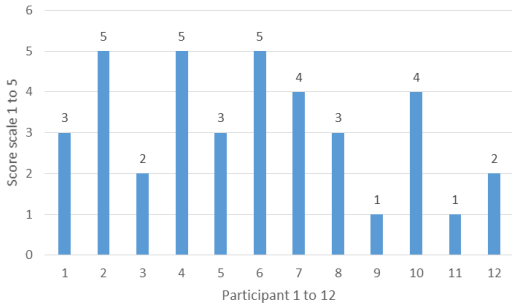


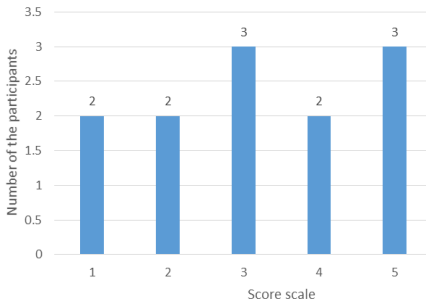
11 **I would recommend this tool to my friends and family**



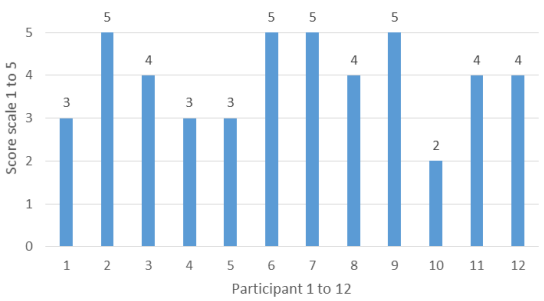


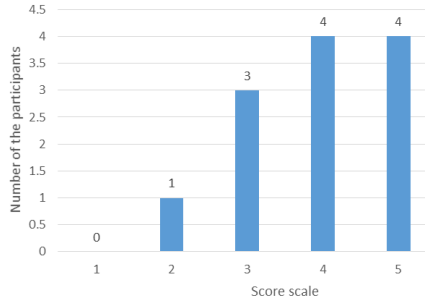
12 **I do not see any reason to use this tool in the future**



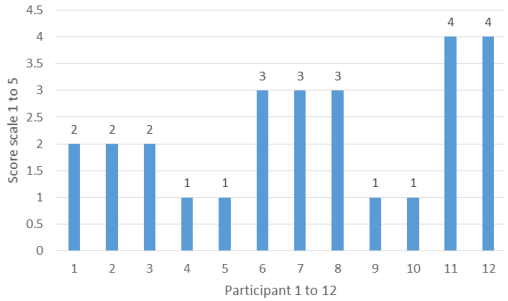


13 **I was satisfied with the tool as a whole**





14 **I have used this tool many times**



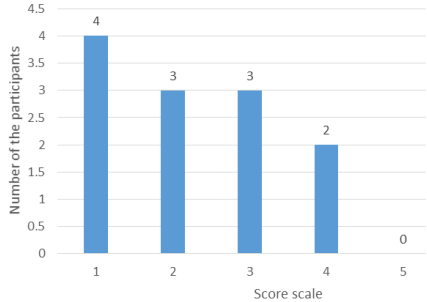


Figure 4-2-3-1 shows the demographic for the Online Air Quality Perception Questionnaire. Out of 12 participants: (i) 75% are male, 17% are female, and 8% did not answer their gender; (ii) 50% of the participants are in the age between 25-34 and 35-44 (25% for each age group respectively), 17% between 45-54, 16% between 18-24 and above 65 (8% for each age group respectively), 17% did not specific which age group they belong to; (iii) most participants (84%) are highly educated either with Ph.D degree (50%) or master degree (34%), 8% of the participants have bachelor degree, and 8% did not answer what education level they have; (iv) three participants are from Haifa, followed with Oslo, Barcelona and Ljubljana (2 from each city), Ostrava (1), Philippines (1), and one did not answer in which city he did evaluate the Online Air Quality Perception Questionnaire; (v) six participants work in the city where they evaluated the Online Air Quality Perception Questionnaire, other participants either live and work there (1) or study there (1), did not answer (1) or chose other ways (3) connecting to the city where they evaluated the Online Air Quality Perception Questionnaire; (vi) 11 participants expressed that they are very interested in (7) or interested in (4) air quality related issues in general, one participant did not answer.

With regard to the users' feedback on the Online Air Quality Perception Questionnaire's user friendliness, from Table 4-2-3-1, we can see that out of 12 participants: (i) four (2 + 2) participants expressed that they would like to use the Online Air Quality Perception Questionnaire frequently, seven (3+4) showed they would not use the Online Air Quality Perception Questionnaire frequently, one showed his intermediate point of view on it; (ii) nine (7+2) participants thought the Online Air Quality Perception Questionnaire is quite simple, two (1+1) thought the Online Air Quality Perception Questionnaire is unnecessary complex, one did express their intermediate point of view on it; (iii) nine (3+6) participants thought the Online Air Quality Perception Questionnaire is easy to use, three did express their intermediate point of view on it; (iv) one (1+0) participants indicated that he need the support of a technical person to be able to use the Online Air Quality Perception Questionnaire, 10 (9+1) participants indicated that they can use the Online Air Quality Perception Questionnaire without the support from a technical person, and one did express his intermediate point of view on it; (v) eight (3+5) participants thought the various function in the Online Air Quality Perception Questionnaire were well integrated, one (0+1) thought the various function in the Online Air Quality Perception Questionnaire were not well integrated, three did indicate their intermediate point of view on it; (vi) 10 (7+3) participants thought that there were not too much inconsistency in the Online Air Quality Perception Questionnaire, one (1+0) thought there were too much inconsistency in the Online Air Quality Perception Questionnaire, one indicated his intermediate point of view on it; (vii) two (2+0) participants indicated that it is easy to learn how to use the Online Air Quality Perception Questionnaire, eight (5+3) thought it is not easy to learn how to use the Online Air Quality Perception Questionnaire, two did indicate their intermediate point of view on it; (viii) seven (3+4) participants felt very confident using the Online Air Quality Perception Questionnaire, one (0+1) felt not very confident using the Online Air Quality Perception Questionnaire, three indicated their intermediate point of view on it, and one did not know if he felt very confident using the Online Air Quality Perception Questionnaire or not; (ix) one (1+0) participant needed to learn a lot of things before he could get going with the Online Air Quality Perception Questionnaire, 10 (9+1) did not need to learn a lot of things before they could get going with the Online Air Quality Perception Questionnaire, one indicated his intermediate point of view on it; (x) two (2+0) participants have learned something useful by using the Online Air Quality Perception Questionnaire, four (1+3) indicated that they have not learned things useful by using the Online Air Quality Perception Questionnaire, six indicated their intermediate point of view on it; (xi) six (4+2) participants would like to recommend the Online Air Quality Perception Questionnaire to their friends and family, three (0+3) would not recommend the Online Air Quality Perception Questionnaire to their friends and family, three indicated their

intermediate point of view on it; (xii) five (2+3) participants did not see any reason to use the Online Air Quality Perception Questionnaire in the future, four (2+2) did see the potentials to use the Online Air Quality Perception Questionnaire in the future, three indicated their intermediate point of view on it; (xiii) eight (4+4) participants were satisfied with the Online Air Quality Perception Questionnaire as a whole, one (0+1) were not satisfied with the Online Air Quality Perception Questionnaire as a whole, three did indicate their intermediate point of view on it; (xiv) two (2+0) participants have used the Online Air Quality Perception Questionnaire many times, seven (4+3) have not used the Online Air Quality Perception Questionnaire many times, three indicated their intermediate point of view on it.

4.2.4 Environmental Monitoring Toolkit in Public Spaces

Eight participants evaluated the environmental monitoring toolkit in public spaces, and the results are presented in Figure 4-2-4-1, Tables 4-2-4-1, 4-2-4-2.

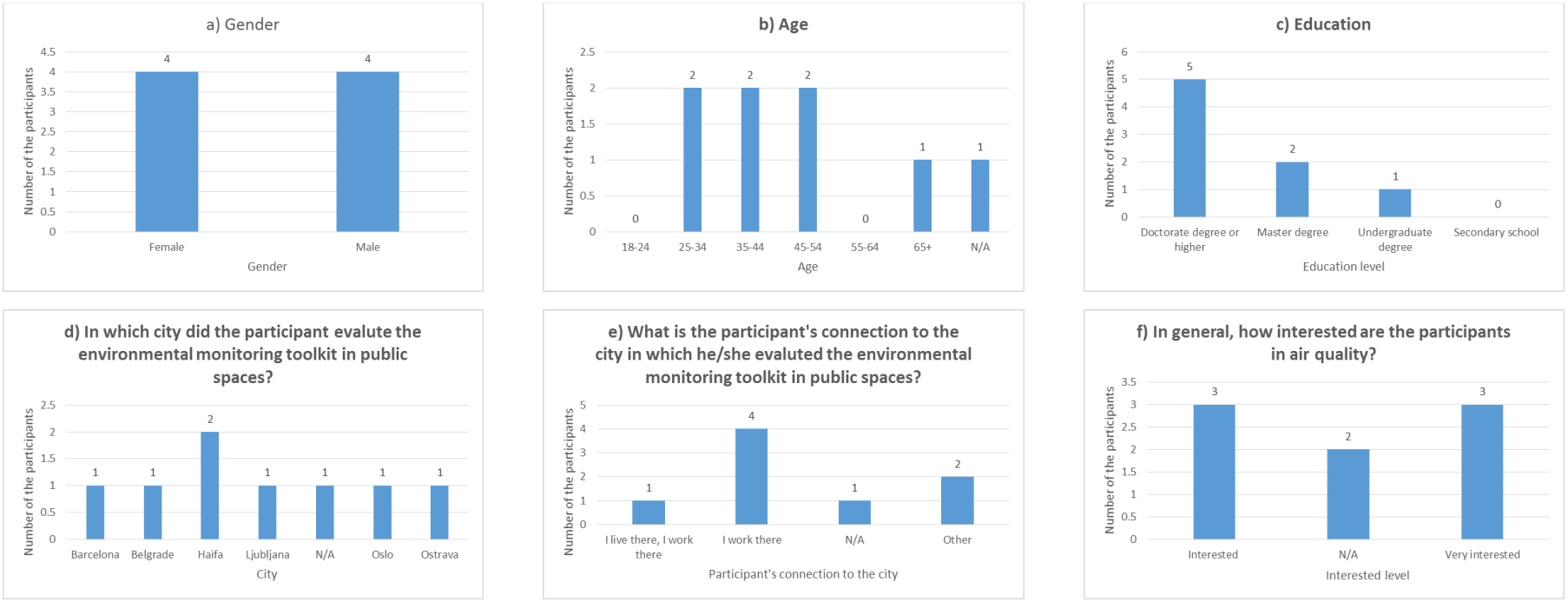
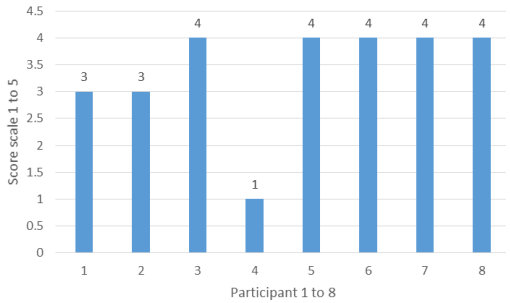
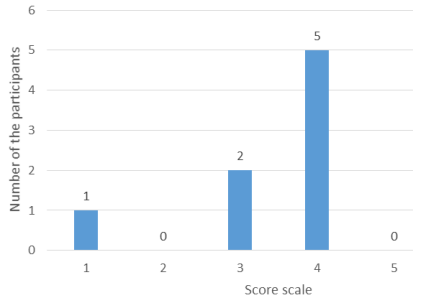
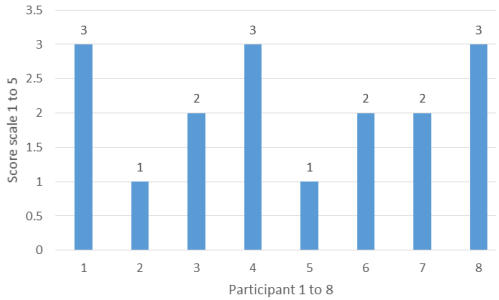
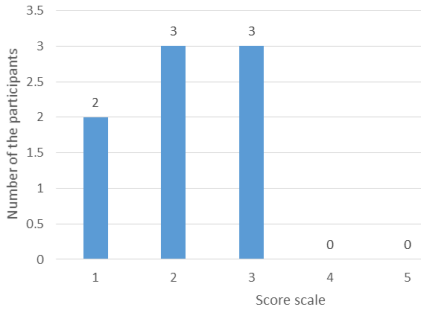
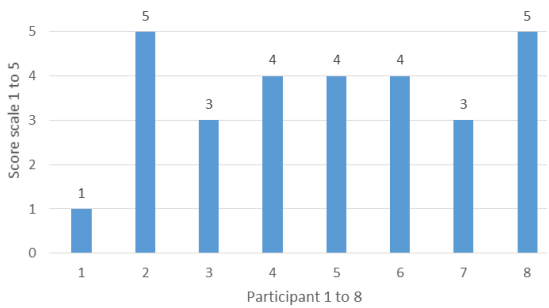


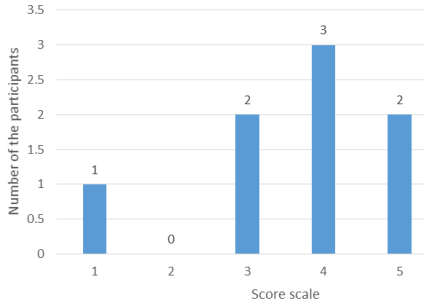
Figure 4-2-4-1. Environmental Monitoring Toolkit in Public Spaces usability evaluation – users' basic information (N/A: not answered).

Table 4-2-4-1. Environmental Monitoring Toolkit in Public Spaces usability assessment – users' feedback – quantified (1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree; N/A: not answered).

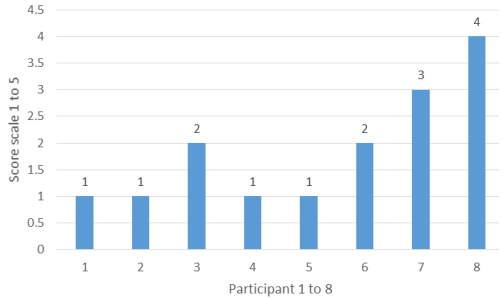
Question No.	Usability questions	Result	
1	I would like to use this tool frequently		
2	The tool unnecessary complex		

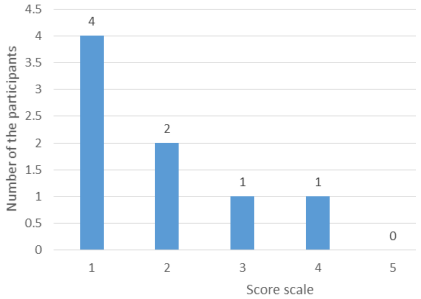
3 **The tool was easy to use**



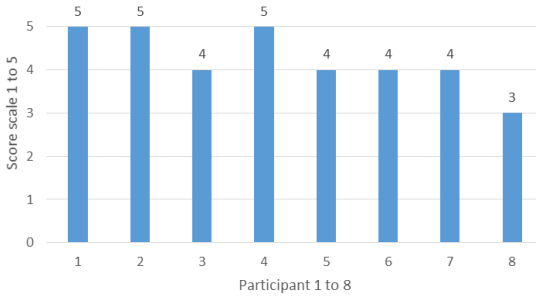


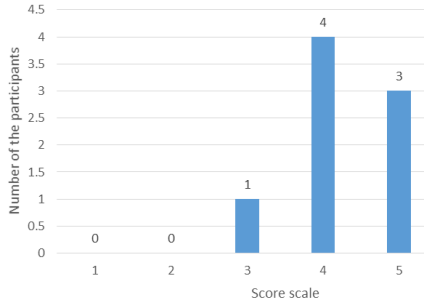
4 **I need the support of a technical person to be able to use this tool**



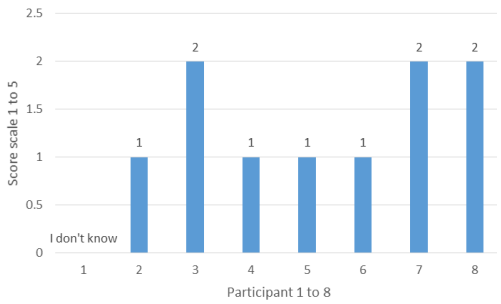


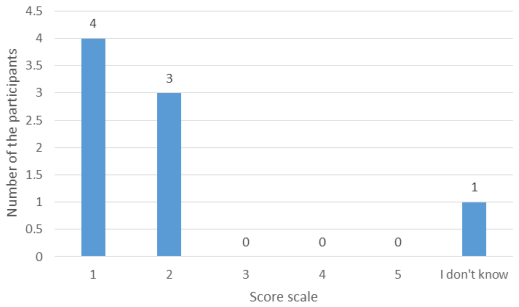
5 **The various functions in this tool were well integrated**



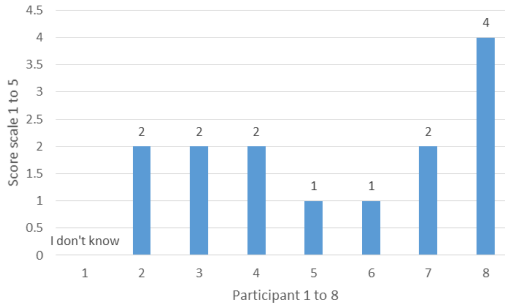


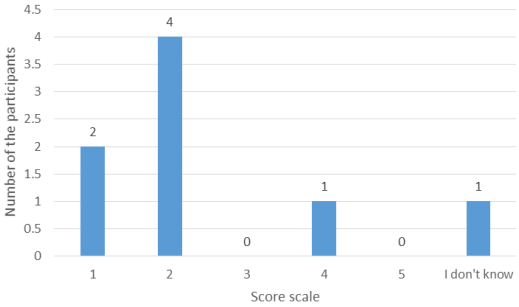
6 **I thought there were too much inconsistency in this system**



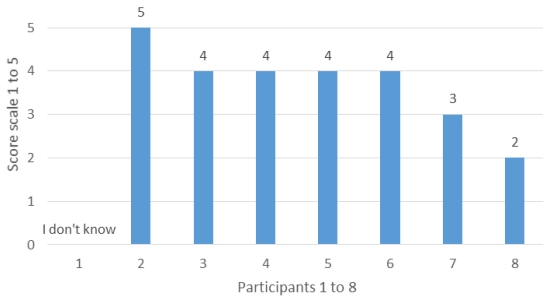


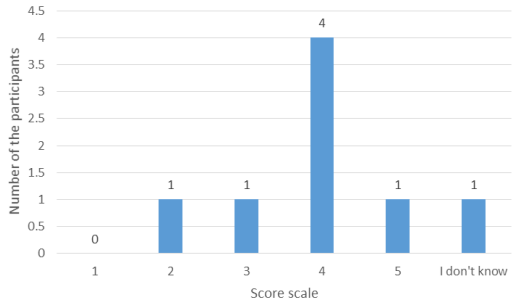
7 **It easy to learn how to use this tool**



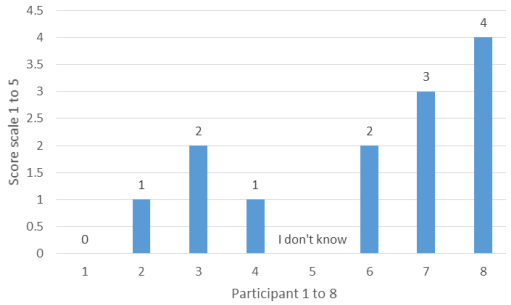


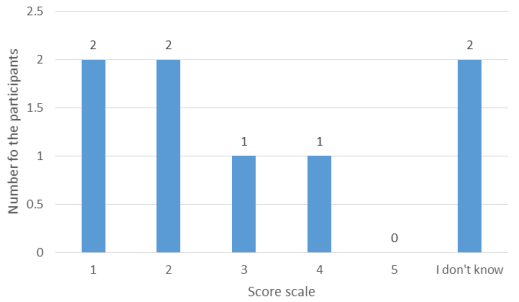
8 **I felt very confident using the tool**



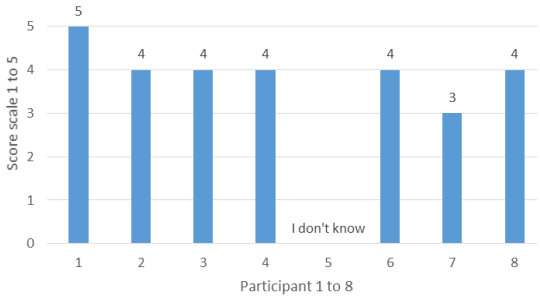


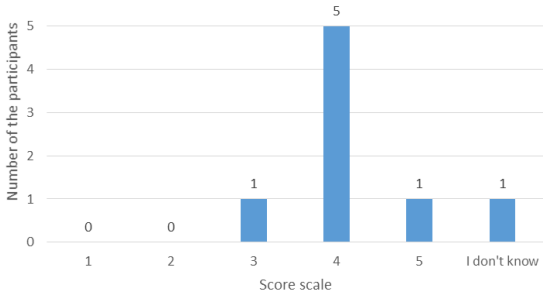
9 **I needed to learn a lot of things before I could get going with this tool**



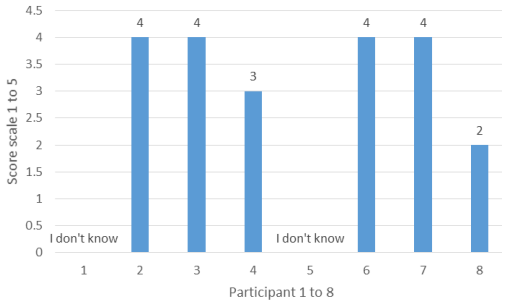


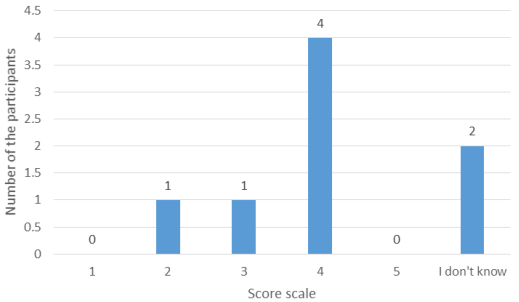
10 **I have learned something useful by using this tool**



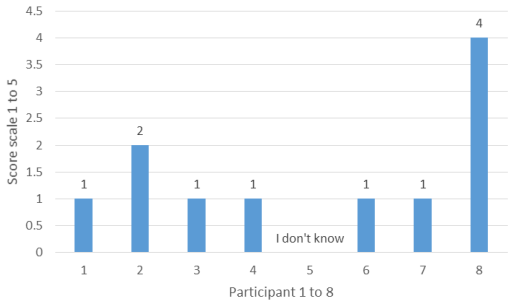


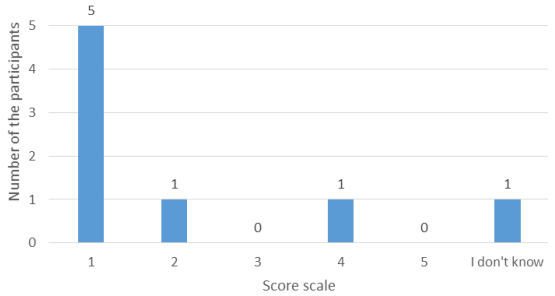
11 **I would recommend this tool to my friends and family**



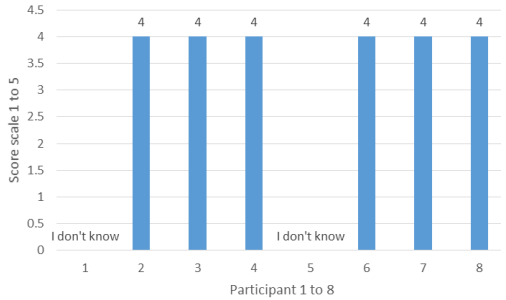


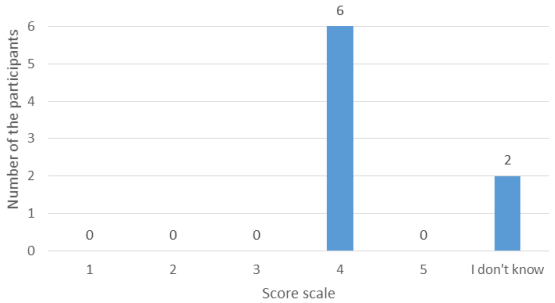
12 **I do not see any reason to use this tool in the future**



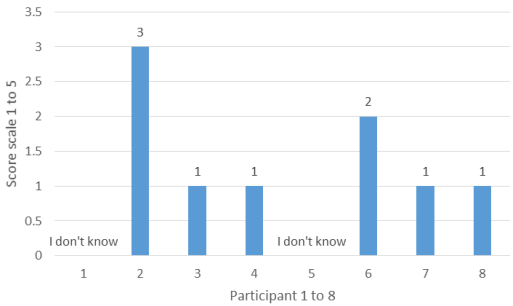


13 **I was satisfied with the tool as a whole**





14 **I have used this tool many times**



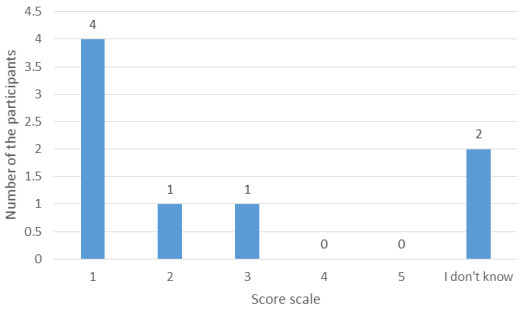


Figure 4-2-4-1 shows demographics for the Environmental Monitoring Toolkit for Public Spaces, evaluated by eight participants (four are male, four are female). (i) six participants are in the age between 25-34, 35-44 and 45-54, two for each age group, respectively, one participant is above 65, and one did not specific which age group they belong to; (ii) seven participants are highly educated either with Ph.D degree (5) or master degree (2), and one participants have bachelor degree; (iii) two participants are from Haifa, followed by Oslo, Barcelona, Ljubljana, Belgrade, Ostrava (1 from each city), and one participant did not answer in which city he/she did evaluate the Environmental Monitoring Toolkit in Public Spaces; (iv) four participants work in the city where they evaluated the Environmental Monitoring Toolkit in Public Spaces, other participants either live and work there (1) or did not answer (1) or chose other ways (2) connecting to the city where they evaluated the Environmental Monitoring Toolkit in Public Spaces; (v) six participants expressed that they are very interested in (3) or interested in (3) air quality related issues in general, and two participants did not answer.

With regard to the users' feedback on the Environmental Monitoring Toolkit in Public Spaces' user friendliness, from Table 4-2-4-1, we can see that out of eight participants: (i) five (5+0) expressed that they would like to use the Environmental Monitoring Toolkit in Public Spaces frequently, one (1+0) showed they would not use the Environmental Monitoring Toolkit in Public Spaces frequently, two showed their intermediate point of view on it; (ii) five (2+3) thought the Environmental Monitoring Toolkit in Public Spaces is quite simple, three did express their intermediate point of view on it; (iii) five (3+2) thought the Environmental Monitoring Toolkit in Public Spaces is easy to use, one (1+0) thought the Environmental Monitoring Toolkit in Public Spaces is not easy to use, two did express their intermediate point of view on it; (iv) one (1+0) indicated that she need the support of a technical person to be able to use the Environmental Monitoring Toolkit in Public Spaces, six (4+2) indicated that they can use the Environmental Monitoring Toolkit in Public Spaces without the support from a technical person, and one did express her intermediate point of view on it; (v) seven (4+3) thought the various function in the Environmental Monitoring Toolkit in Public Spaces were well integrated, one did indicate her intermediate point of view on it; (vi) seven (4+3) thought that there were not too much inconsistency in the Environmental Monitoring Toolkit in Public Spaces, one did not know if there were too much inconsistency in the Environmental Monitoring Toolkit in Public Spaces or not; (vii) one (1+0) indicated that it is easy to learn how to use the Environmental Monitoring Toolkit in Public Spaces, six (2+4) thought it is not easy to learn how to use the Environmental Monitoring Toolkit in Public Spaces, one did not know if it is easy to learn how to user the Environmental Monitoring Toolkit in Public Spaces or not; (viii) five (4+1) felt very confident using the Environmental Monitoring Toolkit in Public Spaces, one (0+1) felt not very confident using the Environmental Monitoring Toolkit in Public Spaces, one indicated her intermediate point of view on it, and one did not know if she felt very confident using the Environmental Monitoring Toolkit in Public Spaces or not; (ix) one (1+0) needed to learn a lot of things before she could get going with the Environmental Monitoring Toolkit in Public Spaces, four (2+2) did not need to learn a lot of things before they could get going with the Environmental Monitoring Toolkit in Public Spaces, one indicated her intermediate point of view on it, and two did not know if they need to learn a lot of things before they could get going with the Environmental Monitoring Toolkit in Public Spaces; (x) six (5+1) have learned something useful by using the Environmental Monitoring Toolkit in Public Spaces, one indicated her intermediate point of view on it, and one did not know if she has learned something useful by using the Environmental Monitoring Toolkit in Public Spaces; (xi) four (4+0) would like to recommend the Environmental Monitoring Toolkit in Public Spaces to their friends and family, one (0+1) would not recommend the Environmental Monitoring Toolkit in Public Spaces to her friends and family, one indicated her intermediate point of view on it, and two did not know if they would recommend the Environmental Monitoring Toolkit in

Public Spaces to their friends and family; (xii) one (1+0) did not see any reason to use the Environmental Monitoring Toolkit in Public Spaces in the future, six (5+1) did see the potentials to use the Environmental Monitoring Toolkit in Public Spaces in the future, one did not know if she see any reason to use the Environmental Monitoring Toolkit in Public Spaces in the future; (xiii) six (6+0) were satisfied with the Environmental Monitoring Toolkit in Public Spaces as a whole, two did not know if they were satisfied with the Environmental Monitoring Toolkit in Public Spaces as a whole or not; (xiv) five (4+1) have not used the Environmental Monitoring Toolkit in Public Spaces many times, one indicated her intermediate point of view on it, and two did not know if they have used the Environmental Monitoring Toolkit in Public Spaces many times or not.

4.2.5 Data Visualization Web Portal for Outdoor Air Quality

16 participants evaluated the data visualization web portal for outdoor air quality and indoor air quality in schools. The results are presented in Figure 4-2-5-1, Tables 4-2-5-1, 4-2-5-2.

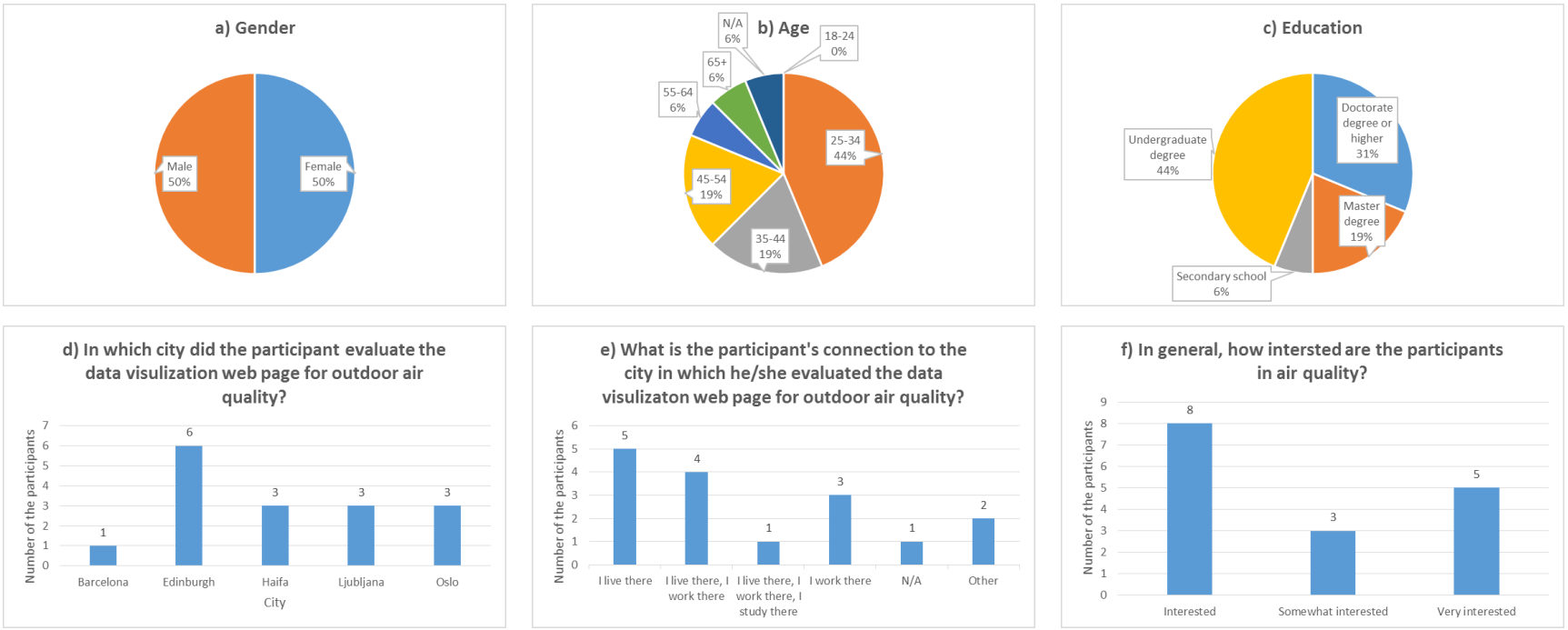
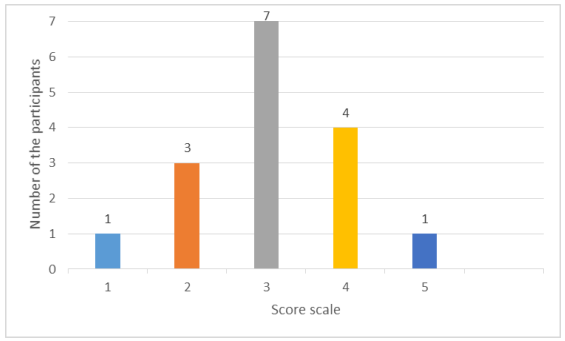
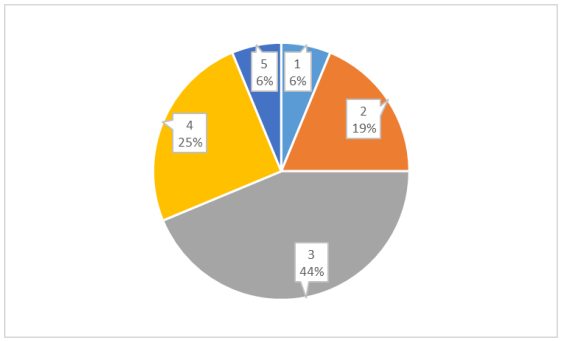
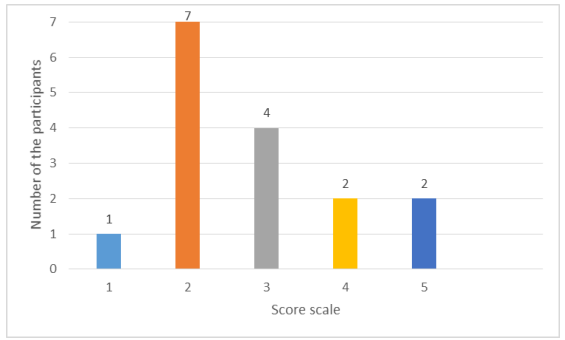
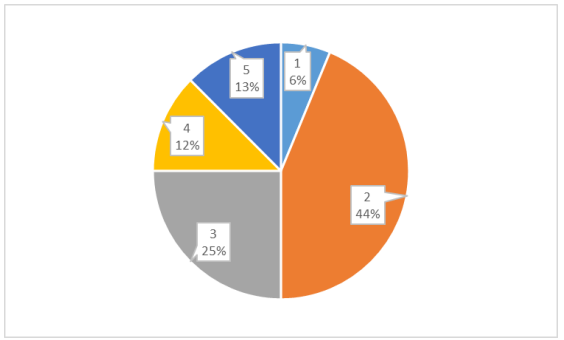
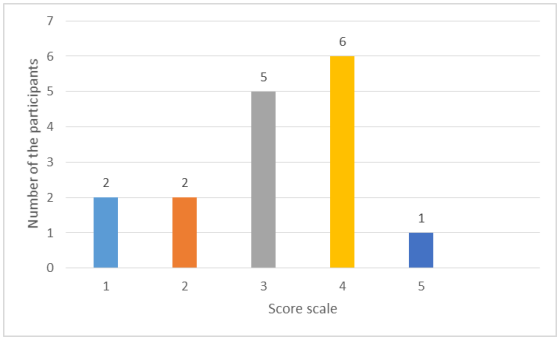


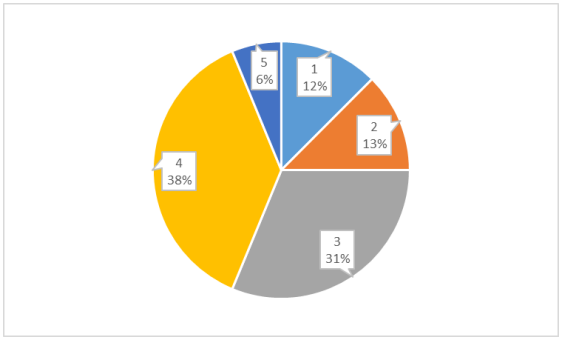
Figure 4-2-5-1. Data Visualization Web Portal for Outdoor Air Quality usability evaluation – users' basic information (N/A: not answered).

Table 4-2-5-1. Data Visualization Web Portal for Outdoor Air Quality usability assessment – users' feedback – quantified (1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree; N/A: not answered).

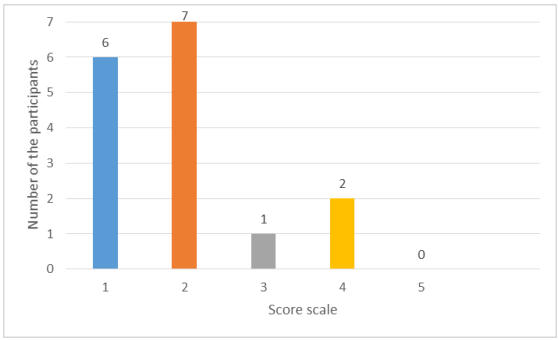
Question No.	Usability questions	Results	
1	I would like to use this tool frequently		
2	The tool unnecessary complex		

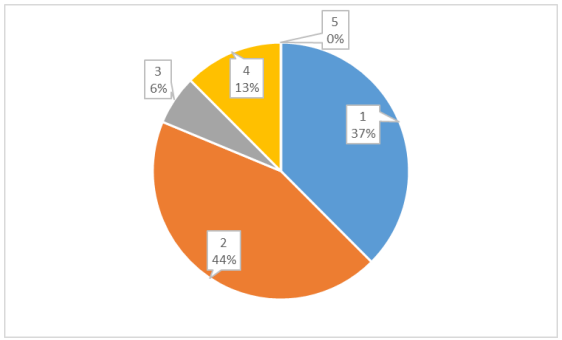
3 **The tool was easy to use**

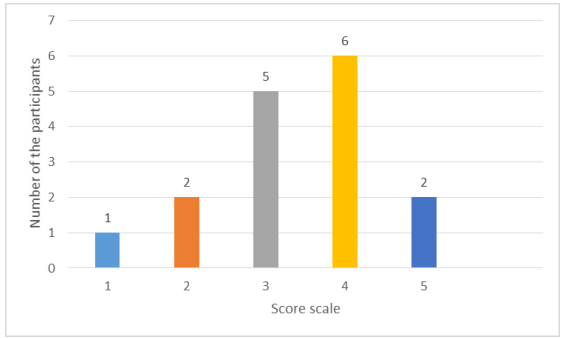
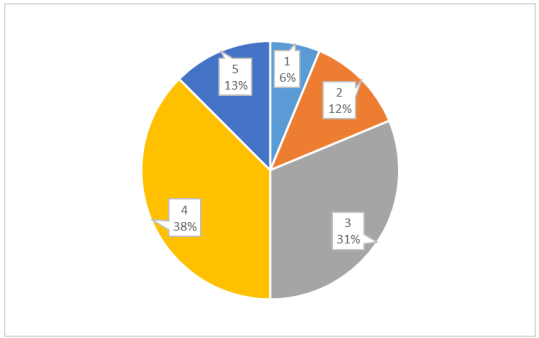
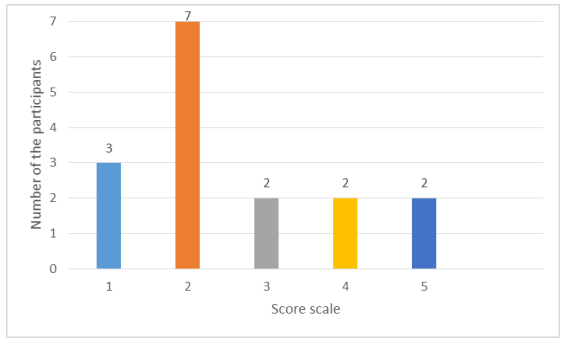
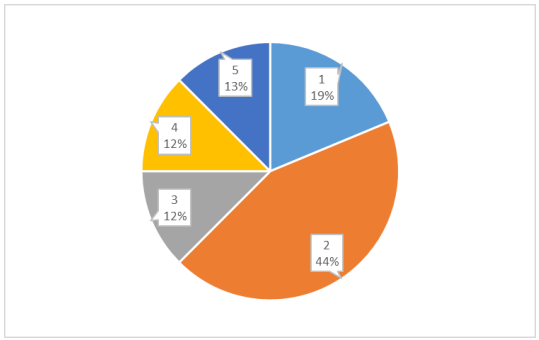




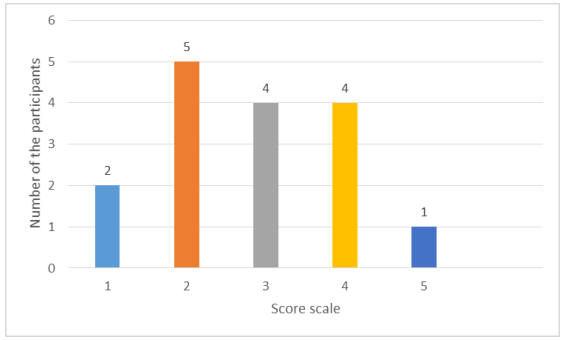
4 **I need the support of a technical person to be able to use this tool**

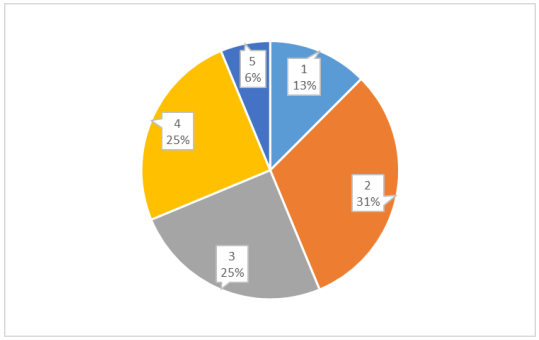




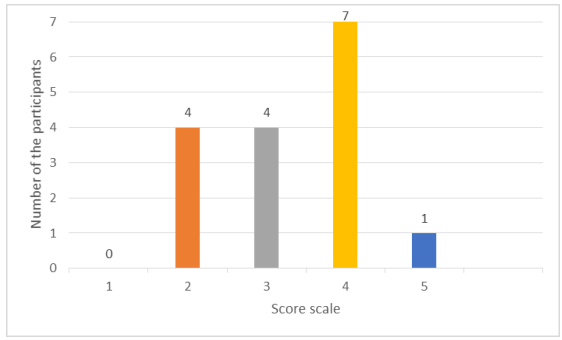
5	**The various functions in this tool were well integrated**		
6	**I thought there were too much inconsistency in this system**		

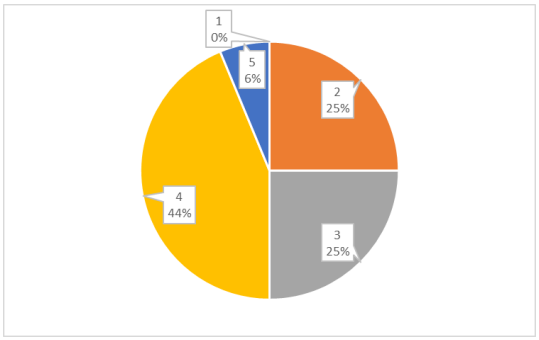
7 **It easy to learn how to use this tool**

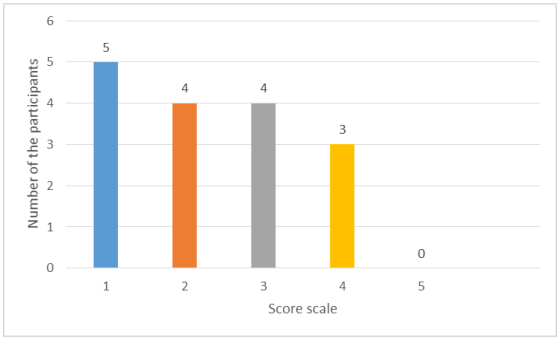
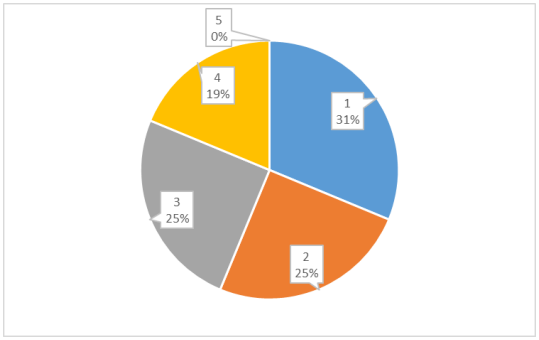
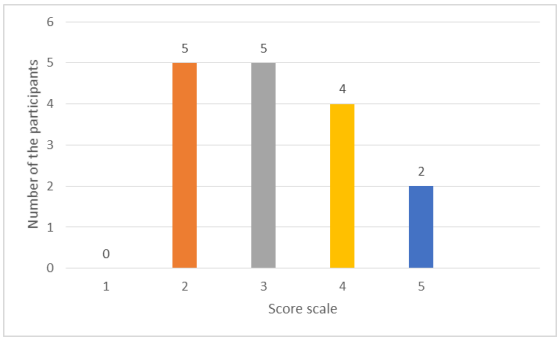
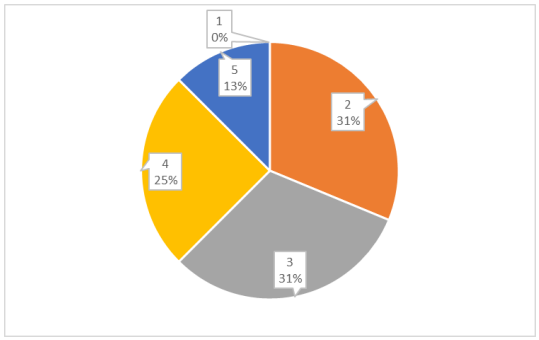


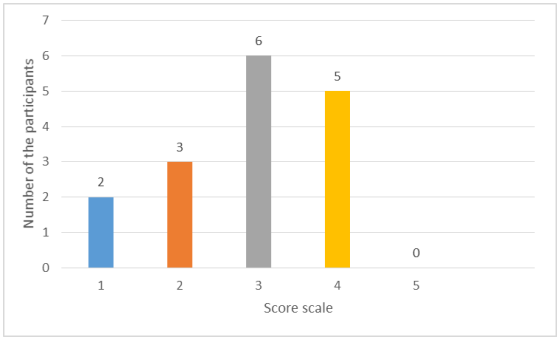
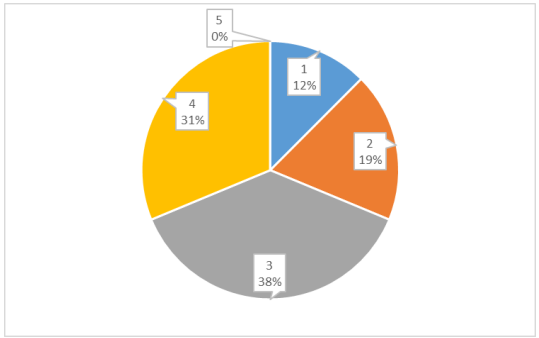
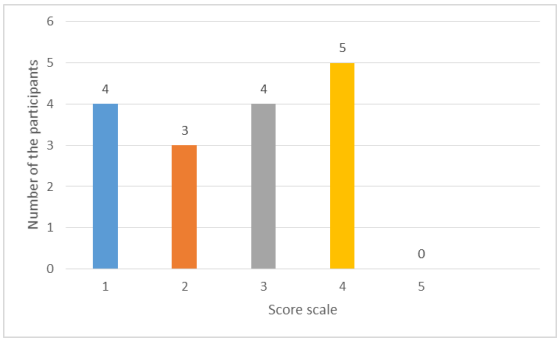
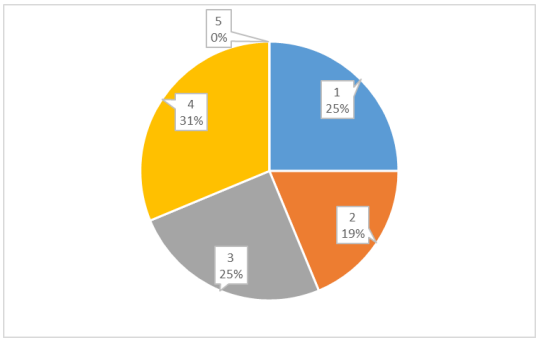


8 **I felt very confident using the tool**

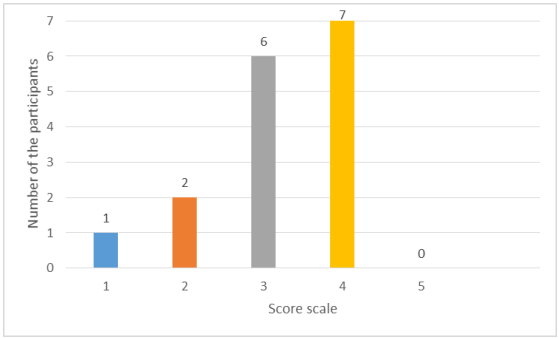


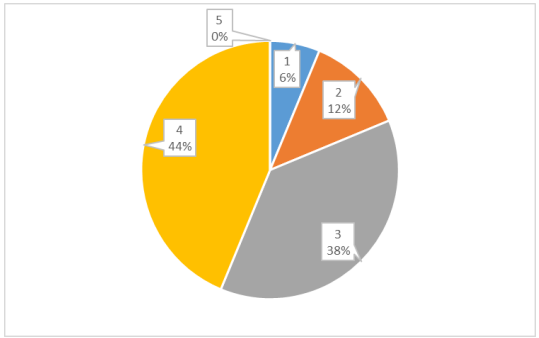


9	**I needed to learn a lot of things before I could get going with this tool**		
10	**I have learned something useful by using this tool**		

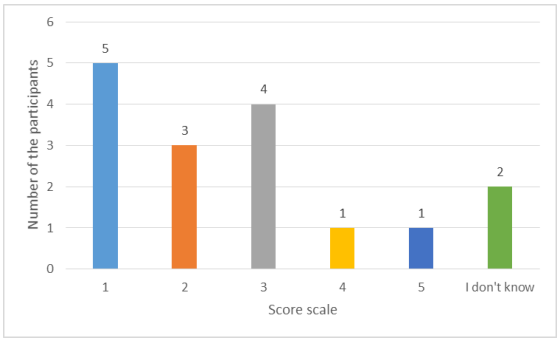
11	**I would recommend this tool to my friends and family**		
12	**I do not see any reason to use this tool in the future**		

13 **I was satisfied with the tool as a whole**





14 **I have used this tool many times**



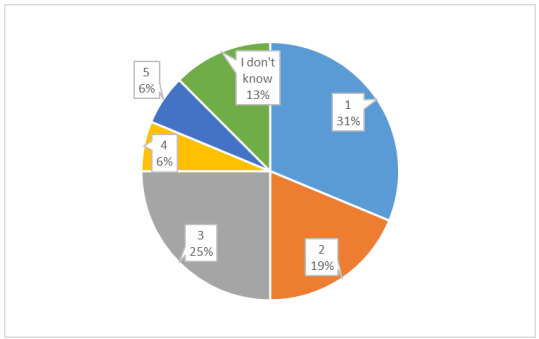


Figure 4-2-5-1 shows demographics for evaluators of the Data Visualisation Web Portal. We can see that out of 16 participants: (i) 50% are male, 50% are female, respectively; (ii) 44% of the participants are in the age between 25-34, 38% are between 35-44 and 45-54 (19% for each age group, respectively), 12 between 55-64 and above 65 (6% for each age group, respectively), and 6% did not specific which age group they belong to; (iii) most of the participants have bachelor degree (44%), following with Ph.D degree (31%), master degree (19%), and secondary school (6%); (iv) six participants are from Edinburgh, followed by Oslo, Haifa and Ljubljana (three from each city), and one participant from Barcelona; (v) 12 participants either live in the city (5) or live and work in the city (4), or work in the city (3) where they evaluated the Data Visualization Web Portal for Outdoor Air Quality, other participants either live and work and study there (1) or did not answer (1) or chose other ways (2) connecting to the city where they evaluated the Data Visualization Web Portal for Outdoor Air Quality; (vi) 13 participants expressed that they are interested in (8) or very interested in (5) air quality related issues in general, and three participants expressed that they are somehow interested in air quality issues.

With regard to the users' feedback on the Data Visualization Web Portal for Outdoor Air Quality's friendliness, we can see from Table 4-2-5-1 that out of 16 participants: (i) 31% (25% + 6%) of the participants expressed that they would like to use the Data Visualization Web Portal for Outdoor Air Quality frequently, 25% (6%+19%) showed they would not use the Data Visualization Web Portal for Outdoor Air Quality frequently, 44% showed their intermediate point of view on it; (ii) 60% (6%+44%) thought the Data Visualization Web Portal for Outdoor Air Quality is quite simple, 25% (12%+13%) thought the Data Visualization Web Portal for Outdoor Air Quality is unnecessary complex, 25% did express their intermediate point of view on it; (iii) 44% (38%+6%) thought the Data Visualization Web Portal for Outdoor Air Quality is easy to use, 25% (12%+13%) thought the Data Visualization Web Portal for Outdoor Air Quality is not easy to use, 31% did express their intermediate point of view on it; (iv) 13% (13%+0%) indicated that they need the support of a technical person to be able to use the Data Visualization Web Portal for Outdoor Air Quality, 81% (44%+37%) indicated that they can use the Data Visualization Web Portal for Outdoor Air Quality without the support from a technical person, and 6% did indicate their intermedia point of view on it; (v) 51% (38%+13%) thought the various function in the Data Visualization Web Portal for Outdoor Air Quality were well integrated, 18% (6%+12%) thought the various function in the Data Visualization Web Portal for Outdoor Air Quality were not well integrated, 31% did indicate their intermediate point of view on it; (vi) 25% (12%+13%) thought that there were too much inconsistency in the Data Visualization Web Portal for Outdoor Air Quality, 63% (44%+19%) thought there were not too much inconsistency in the Data Visualization Web Portal for Outdoor Air Quality, 12% indicated their intermediate point of view on it; (vii) 31% (25%+6%) indicated that it is easy to learn how to use the Data Visualization Web Portal for Outdoor Air Quality, 44% (13%+31%) thought it is not easy to learn how to use the Data Visualization Web Portal for Outdoor Air Quality, 25% did indicate their intermediate point of view on it; (viii) 50% (44%+6%) felt very confident using the Data Visualization Web Portal for Outdoor Air Quality, 25% (0%+25%) felt not very confident using the Data Visualization Web Portal for Outdoor Air Quality, and 25% indicated their intermediate point of view on it; (ix) 19% (19%+0%) needed to learn a lot of things before they could get going with the Data Visualization Web Portal for Outdoor Air Quality, 56% (31%+25%) did not need to learn a lot of things before they could get going with the Data Visualization Web Portal for Outdoor Air Quality, and 25% indicated their intermediate point of view on it; (x) 38% (25%+13%) have learned something useful by using the Data Visualization Web Portal for Outdoor Air Quality, 31% (0%+31%) indicated that they have not learned things useful by using the Data Visualization Web Portal for Outdoor Air Quality, and 31% indicated their intermediate point of view on it; (xi) 31% (31%+0%) would like to recommend the Data Visualization Web Portal for Outdoor Air

Quality to their friends and family, 31% (12%+19%) would not recommend the Data Visualization Web Portal for Outdoor Air Quality to their friends and family, and 38% indicated their intermediate point of view on it; (xii) 31% (31%+0%) did not see any reason to use the Data Visualization Web Portal for Outdoor Air Quality in the future, 44% (25%+19%) did see the potentials to use the Data Visualization Web Portal for Outdoor Air Quality in the future, and 25% indicated their intermediate point of view on it; (xiii) 44% (44%+0%) were satisfied with the Data Visualization Web Portal for Outdoor Air Quality as a whole, 18% (6%+12%) were not satisfied with the Data Visualization Web Portal for Outdoor Air Quality as a whole, and 38% did indicate their intermediate point of view on it; (xiv) 12% (6%+6%) have used the Data Visualization Web Portal for Outdoor Air Quality many times, 50% (31%+19%) have not used the Data Visualization Web Portal for Outdoor Air Quality many times, 25% indicated their intermediate point of view on it and 13% did not know if they have used the Data Visualization Web Portal for Outdoor Air Quality many times or not.

4.2.6 Data Download Web Page

Only one participant evaluated the Data Download Web Page. The results are presented in Tables 4-2-6-1 and 4-2-6-2.

Table 4-2-6-1. Data download web page usability evaluation – users' basic information (N/A: not answered).

Gender (Female=F; Male=M)	Year of birth	Highest education level	In which city did participant evaluate the COWP?	What is participant connection to the city in which participant evaluated the COWP?	In general, how interested are participant in air quality?
F	1975	Doctorate degree or higher	Edinburgh	I work there	Very interested

Table 4-2-6-2. Data download web page usability evaluation – users' feedback – quantified (1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree; N/A: not answered).

Usability questions	Results
I would like to use this tool frequently	5
The tool unnecessary complex	3
The tool was easy to use	2
I need the support of a technical person to be able to use this tool	1
The various functions in this tool were well integrated	2
I thought there were too much inconsistency in this system	3
It easy to learn how to use this tool	4
I felt very confident using the tool	4
I needed to learn a lot of things before I could get going with this tool	1
I have learned something useful by using this tool	1

I would recommend this tool to my friends and family	2
I do not see any reason to use this tool in the future	3
I was satisfied with the tool as a whole	1
I have used this tool many times	1

To summarize, from Table 4-2-6-1 we can see that this participant is female, in the age between 35-44, with Ph.D degree, from Edinburgh, works in Edinburgh, and she is very interested in air quality related issues in general.

From Table 4-2-6-2, we can see that this participant: (i) would like to use the Data Download Web Page frequently; (ii) thought the Data Download Web Page neither unnecessary complex nor unnecessary simple; (iii) thought the Data Download Web Page was not easy to use; (iv) thought she did not need the support of a technical person to be able to use the Data Download Web Page; (v) thought the various function in the Data Download Web Page were not well integrated; (vi) thought there were neither too much inconsistency nor good consistency in the Data Download Web Page; (vii) thought it is easy to learn how to use the Data Download Web Page; (viii) felt very confident using the Data Download Web Page; (ix) did not need to learn a lot of things before they could get going with the Data Download Web Page; (x) have not learned something useful by using the Data Download Web Page; (xi) would not recommend the Data Download Web Page to their friends and family; (xii) neither did not see any reason to use nor did see the potential to use the Data Download Web Page in the future; (xiii) was not satisfied with the Data Download Web Page as a whole; (xiv) have not used the Data Download Web Page many times.

4.2.7 Citizens' Observatories Web Portal

12 participants evaluated the citizens' observatories web portal. The results are presented in Figure 4-2-7-1, Tables 4-2-7-1, 4-2-7-2.

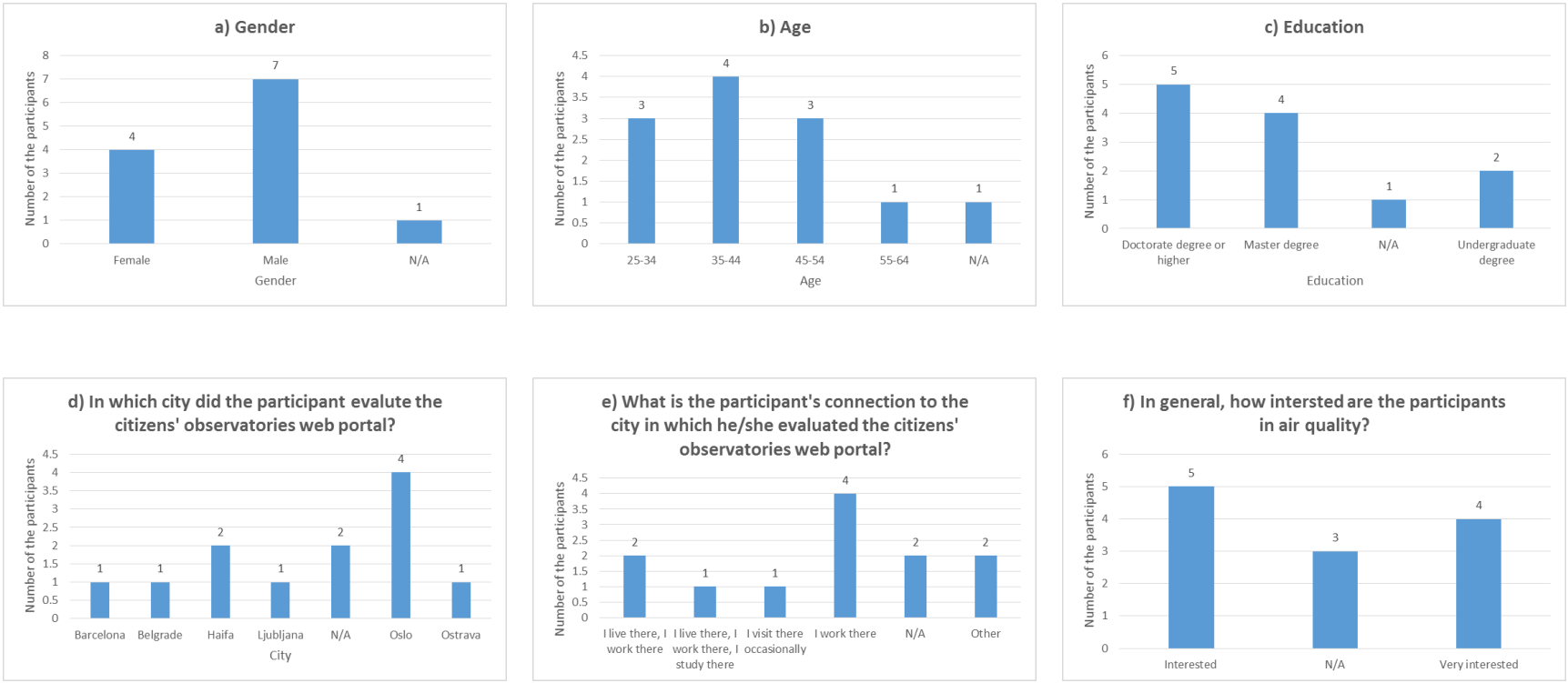
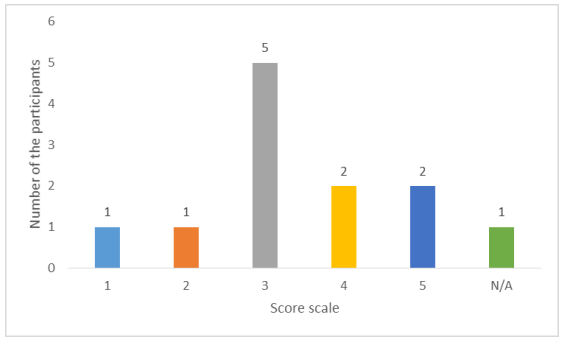
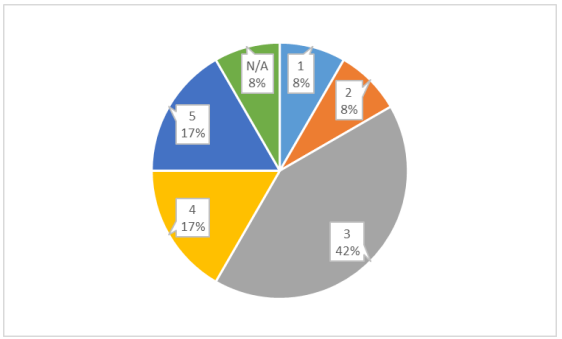
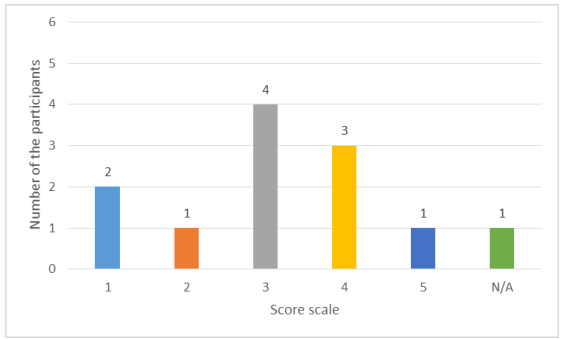
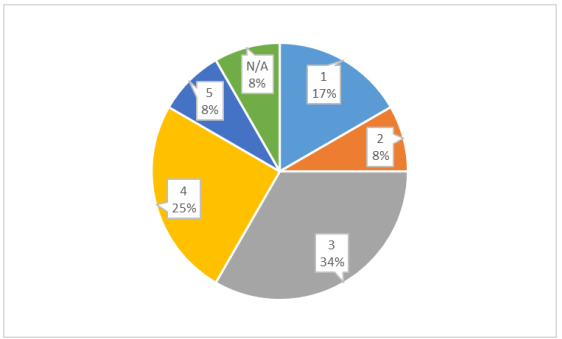
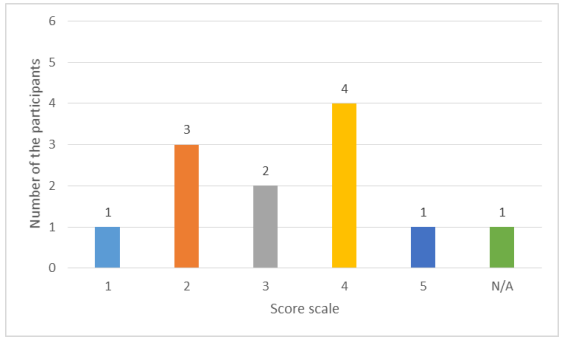
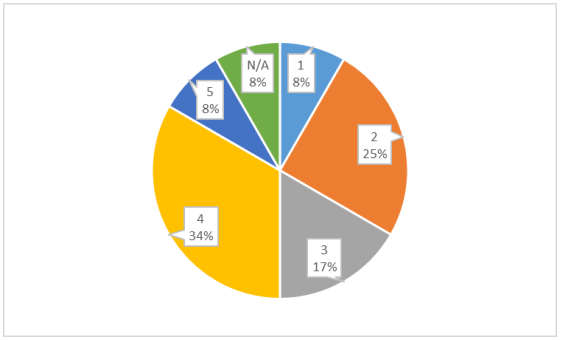
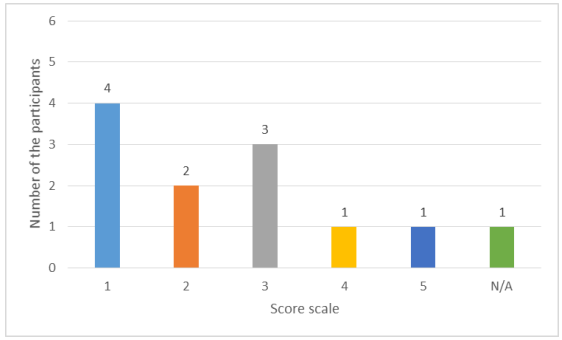
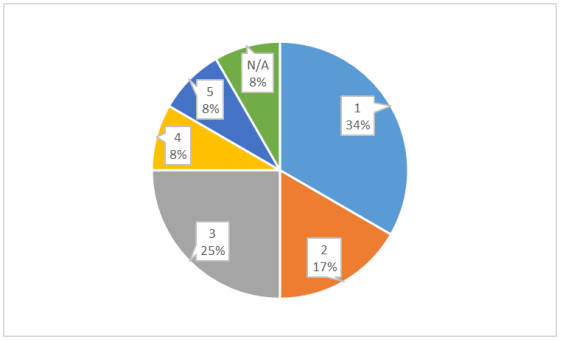
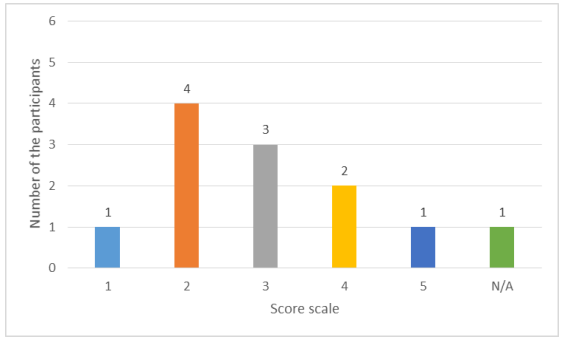
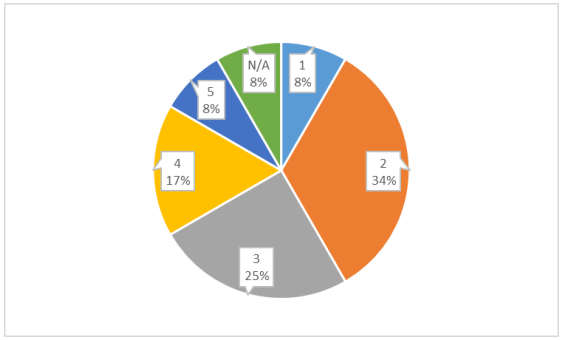
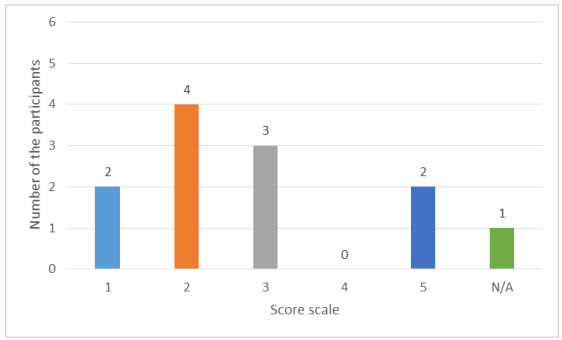
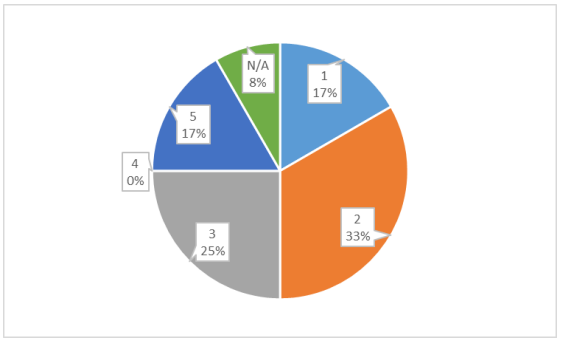


Figure 4-2-7-1. Citizens' Observatories web portal usability evaluation – users' basic information (N/A: not answered).

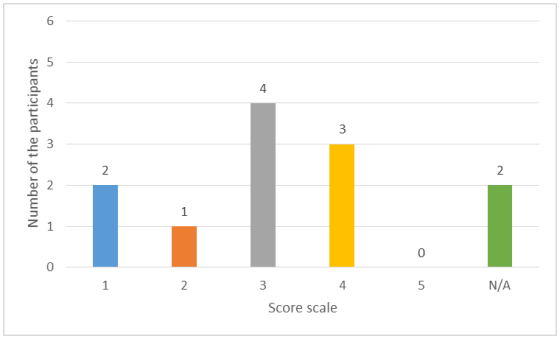
Table 4-2-7-1. Citizens' Observatories web portal usability evaluation – users' feedback – quantified (1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree; N/A: not answered).

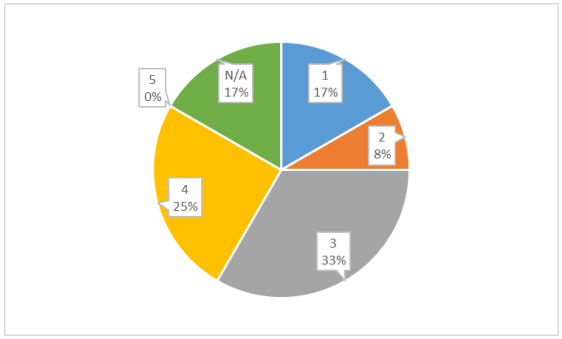
Question No.	Usability questions	Results	
1	I would like to use this tool frequently		
2	The tool unnecessary complex		

3	**The tool was easy to use**		
4	**I need the support of a technical person to be able to use this tool**		

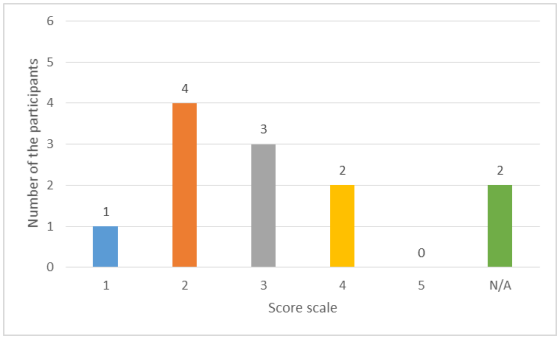
5	**The various functions in this tool were well integrated**		
6	**I thought there were too much inconsistency in this system**		

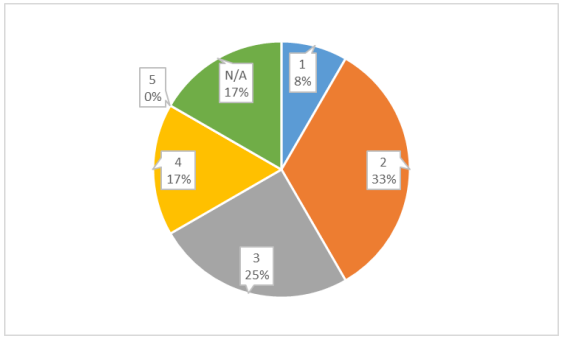
7 **It easy to learn how to use this tool**

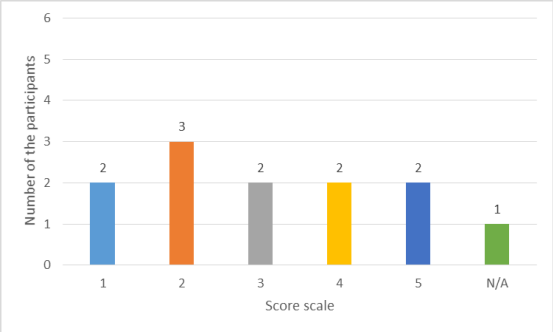
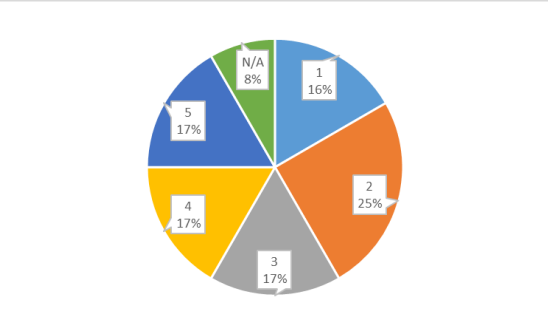
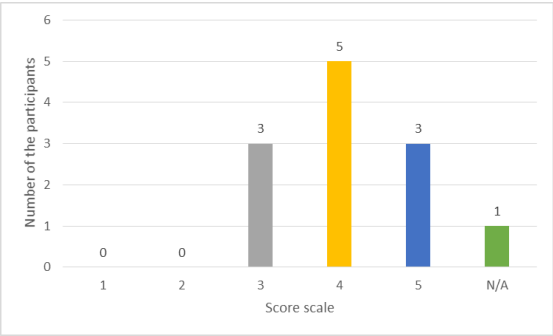
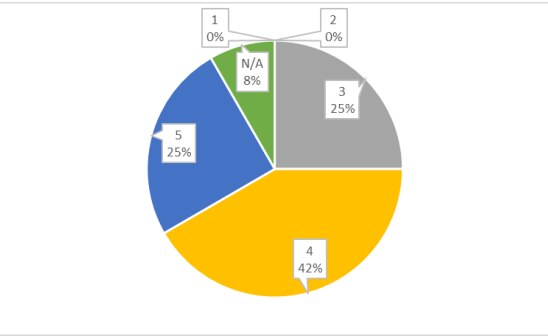


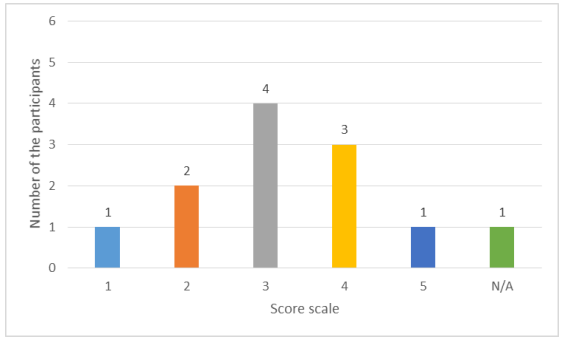
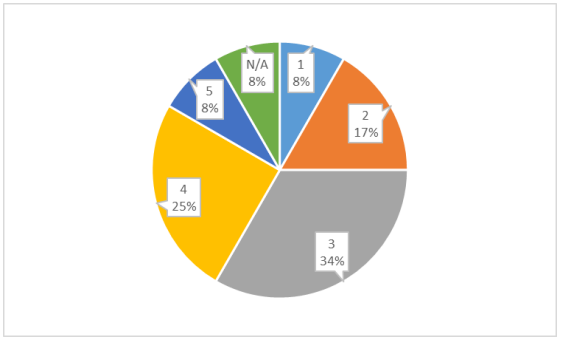
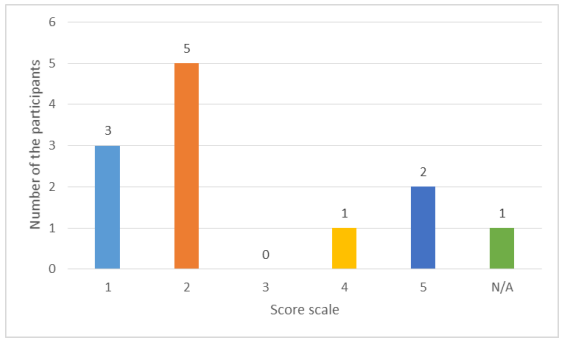
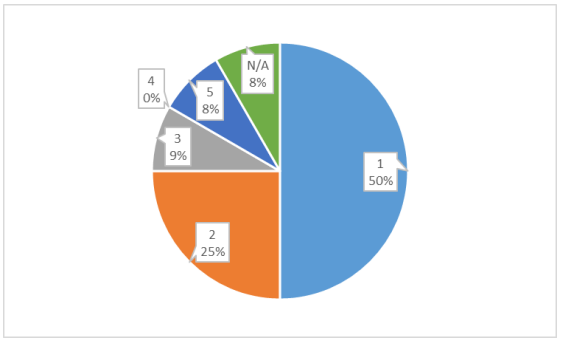


8 **I felt very confident using the tool**

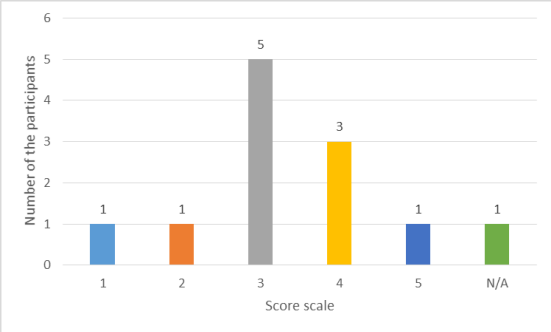


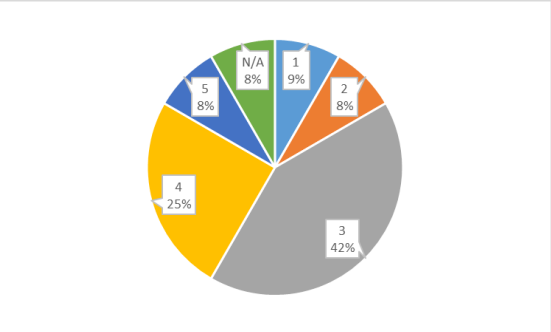


9	**I needed to learn a lot of things before I could get going with this tool**		
10	**I have learned something useful by using this tool**		

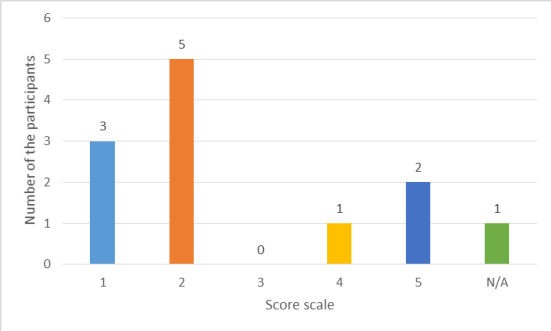
11	**I would recommend this tool to my friends and family**		
12	**I do not see any reason to use this tool in the future**		

13 **I was satisfied with the tool as a whole**





14 **I have used this tool many times**



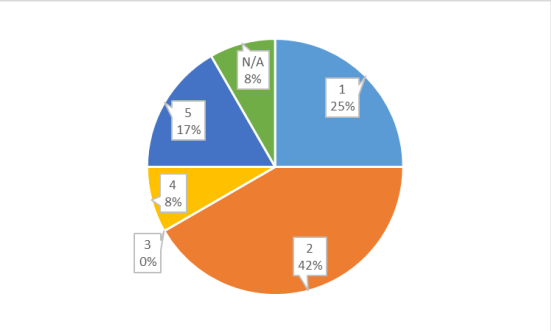


Figure 4-2-7-1 gives information on evaluators on the CO web portal., we can see that out of 12 participants: (i) seven are male, four are female, and one did not answer; (ii) 10 participants are in the age between 25-34 (3), 35-44 (4) and 45-54 (3), one between 55-64 and one did not specific which age group they belong to; (iii) most of the participants are highly educated wither with Ph.D degree (5) or master degree (4), two have bachelor degree, and one did not answer; (iv) four participants are from Oslo, followed by Haifa (2), Ljubljana (1), Barcelona (1), Belgrade (1), Ostrava (1), and two participants did not answer; (v) four participants work in the city, two live and work in the city, one live, work and study in the city, one visits the city occasionally where they evaluated the Citizens' Observatories Web Portal, other participants either did not answer (2) or chose other ways (2) connecting to the city where they evaluated the Citizens' Observatories Web Portal; (vi) nine participants expressed that they are interested in (5) or very interested in (4) air quality related issues in general, and three participants did not answer.

With regard to the users' feedback on the Citizens' Observatories Web Portal user friendliness, from Table 4-2-7-1 we can see that out of 12 participants: (i) 34% (17%+17%) expressed that they would like to use the Citizens' Observatories Web Portal frequently, 16% (8%+8%) showed they would not use the Citizens' Observatories Web Portal frequently, 42% showed their intermediate point of view on it, and 8% did not answer; (ii) 25% (17%+8%) thought the Citizens' Observatories Web Portal is quite simple, 33% (25%+8%) thought the Citizens' Observatories Web Portal is unnecessary complex, 34% did express their intermediate point of view on it, and 8% did not answer; (iii) 44% (34%+8%) thought the Citizens' Observatories Web Portal is easy to use, 33% (25%+8%) thought the Citizens' Observatories Web Portal is not easy to use, 17% did express their intermediate point of view on it, and 8% did not answer; (iv) 16% (8%+8%) indicated that they need the support of a technical person to be able to use the Citizens' Observatories Web Portal, 51% (34%+17%) indicated that they can use the Citizens' Observatories Web Portal without the support from a technical person, 25% did express their intermediate point of view on it and 8% did not answer; (v) 25% (17%+8%) thought the various function in the Citizens' Observatories Web Portal were well integrated, 44% (8%+34%) thought the various functions in the Citizens' Observatories Web Portal were not well integrated, 25% did indicate their intermediate point of view on it and 8% did not answer; (vi) 17% (0%+17%) thought that there were too much inconsistency in the Citizens' Observatories Web Portal, 50% (17%+33%) thought there were good consistency in the Citizens' Observatories Web Portal, 25% did indicate their intermediate point of view on it, and 8% did not answer; (vii) 25% (25%+0%) indicated that it is easy to learn how to use the Citizens' Observatories Web Portal, 25% (17%+8%) thought it is not easy to learn how to use the Citizens' Observatories Web Portal, 33% indicated their intermediate point of view on it and 17% did not answer; (viii) 17% (17%+0%) felt very confident using the Citizens' Observatories Web Portal, 41% (33%+8%) felt not very confident using the Citizens' Observatories Web Portal, 25% indicated their intermediate point of view on it, and 17% did not answer; (ix) 34% (17%+17%) needed to learn a lot of things before they could get going with the Citizens' Observatories Web Portal, 41% (16%+25%) did not need to learn a lot of things before they could get going with the Citizens' Observatories Web Portal, 17% indicated their intermediate point of view on it, and 8% did not answer; (x) 77% (42%+25%) have learned something useful by using the Citizens' Observatories Web Portal, 25% indicated their intermediate point of view on it, and one did not answer; (xi) 33% (25%+8%) would like to recommend the Citizens' Observatories Web Portal to their friends and family, 25% (17%+8%) would not recommend the Citizens' Observatories Web Portal to their friends and family, 34% indicated their intermediate point of view on it, and 8% did not answer; (xii) 75% (50%+25%) did see the potential to use the Citizens' Observatories Web Portal in the future, 8% (8%+0%) did not see any reason to use the Citizens' Observatories Web Portal in the future, 9% indicated their intermediate point of view on it, and 8% did not answer; (xiii) 33% (25%+8%) were satisfied with the Citizens' Observatories Web Portal as a whole, 17% (8%+9%) were not satisfied with the Citizens' Observatories Web Portal, 40%

indicated their intermediate point of view on it, and 8% did not answer if they are satisfied with the Citizens' Observatories Web Portal or not; (xiv) 25% (17%+8%) have used the Citizens' Observatories Web Portal many times, 67% (25%+42%) have not used the Citizens' Observatories Web Portal so often, and 8% did not answer if they have used the Citizens' Observatories Web Portal often or not.

5. Conclusion

The set of methodologies with tools that were developed and evaluated for CITI-SENSE will also be valuable assets for future similar initiatives. At the end of the CITI-SENSE project, the available results for future re-use have been further described from the user perspective of the Citizen' Observatories Toolbox (See D4.5 – The CITI-SENSE Citizens' Observatories Web Portal, Liu et al., 2016), and from the developer's perspective of the same Citizens' Observatories Toolbox (D7.6 – CITI-SENSE Platform and architecture Version 4 - Part 3: Citizen Observatory Toolbox - Developer perspective, Berre et al., 2016)

From the KPIs assessment results, we can conclude that developers gave a relatively higher score for the methodologies they developed than the project internal methodologies users did. This may indicate that from the methodology developers' point of view, the methodologies they developed achieved good or quite effective success toward their planned objective. However, from the users' perspective, for several of the methodologies, there was lack of enough users' involvement in the methodologies development process. From this perspective, several of the methodologies attained a fair or relatively low level of the project's defined objectives.

To average both the developers and users evaluations, we can conclude that:

(i) **Sensors and Sensor Platforms**: LEO, Obeo radon sensor and Atmospheric sensor package have fair or relatively low achievement of the project objective defined, AQMesh has reached moderate or quite effective success, Environmental Monitoring Toolkit in Public Spaces reached good or effective success, SEDS platform has reached moderate or quite effective success;

(ii) **Surveys**: Both CityAir App and Online Air Quality Perception Questionnaire have achieved good or quite effective success;

(iii) **Web portals and Maps**: Data visualization Web Portal for Public Spaces Empowerment Initiatives achieved very good or very effective success, Data Visualization Web Portal for Outdoor Air Quality and Data Download Web Page have moderate or quite effective success, Citizens' Observatories Web Portal has reached moderate or quite effective success, and Data Fusion Maps reached good or effective success.

(iv) Based upon the usability evaluation results, about **Users' Basic Information**, we can conclude that within those users who have evaluated one or several of the CITI-SENSE methodologies: (i) more males than females; (ii) more in the middle age (25-54) than in the younger age (18-24) and older age (+65); most are highly educated either with Ph.D or master's degree, less are relatively lower educated either with bachelor or secondary school degree; more are from Oslo than other cities in CITI-SENSE; most work and/or live in the city, less are students and/or visit the city occasionally in which they have evaluated the CITI-SENSE methodologies; most are interested in or very interested in air quality related issues in general, and less are somehow interested in air quality issues, and no one is not at all interested in air quality issues.

From the usability evaluation results related to the Users' Feedback about the **Methodologies' Friendliness**, we can conclude that more participants (above 50% of the total participants) indicated that they:

(v) would not use the **LEO** frequently, can use it without the support from a technical person, did not need to learn a lot of things before they could get going with it, have learned something useful by using it, may not recommend it to their friends and/or family, did see the great potential to use the it in the future, and have not used it many times;

(vi) thought the **CityAir App** is quite simple and easy to use, they can use it without the support form a technical person, thought the various function in it were well integrated and were not

so much inconsistency in it, thought it is easy to learn how to use the it, felt very confident using it, did not need to learn a lot of things before they could get going with it, did see the potentials to use it in the future;

(vii) would not use the **Online Air Quality Perception Questionnaire** frequently; they thought it is quite simple and easy to use, they can use it without the support from a technical person, thought the various function in it were well integrated and were not too much inconsistency in it, thought it is easy to learn how to use it, felt very confident using it, did not need to learn a lot of things before they could get going with it, were satisfied with it as a whole, and have not used it many times;

(viii) would like to use the **Environmental Monitoring Toolkit in Public Spaces** frequently, thought it is quite simple and easy to use, can use it without the support from a technical person, thought the various function in it were well integrated and were not too much inconsistency in it, thought it is not easy to learn how to use it, felt very confident using it, have learned something useful by using it, did see the potentials to use it in the future, were satisfied with it as a whole, have not used it many times;

(ix) thought the **Data Visualization Web Portal for Outdoor Air Quality** is quite simple, can use it without the support from a technical person, thought the various function in it were well integrated and were not too much inconsistency in it, and did not need to learn a lot of things before they could get going with it;

(x) can use the **Citizens' Observatories Web Portal** without the support from a technical person, thought there were good consistency in it, have learned something useful by using it, did see the potential to use it in the future, and have not used it so often.

6. References

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