SUSTAINABLE USE OF PAPER AT Wageningen UR AN ICT TRANSLATION ISSUE

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1. INTRODUCTION

Wageningen University and Research Centre (Wageningen UR) is noted, among other reasons, for its emphasis on sustainable operational management, transmission of knowledge and recommendation for developmental policies in a sustainable manner. For Wageningen UR, sustainability is more than an important principle; it is a value at the basis of its existence. This is further explained by the Safety & Environment department of Wageningen UR (2012):

> *"If Wageningen UR fails to comply with this, then sustainability will eventually prove to be disadvantageous to Wageningen UR, by scoring low in benchmarks, the allocation of projects and perhaps the number of students who opt for Wageningen UR."* (p. 7)

At the same time, the university, as part of its academic drive, provides diverse forms of making academic material accessible to students. These include upload of academic articles and literature (i.e. softcopies on Blackboard), as well as the university's website, thus placing knowledge at the doorstep of students.

1.1 Problem statement

The sustainability value of Wageningen UR seems to be in contradiction with the amount of printing by students and staff. For instance, it remains a practice for students to print hardcopies of academic material[1] that is often not reused after each period. A similar trend can be observed among educational staff at the university, as they are used to printing materials required for academic purposes. This makes the current printing practices a potential problem that goes beyond student body.

The Wageningen UR Annual Report 2012 (Wageningen UR, 2013) stated that the institution has three main streams of waste: industrial waste, paper waste and hazardous waste. Paper waste is the second most important in terms of amount of waste generated. Even though Wageningen UR reduced its paper waste by 40% compared to 2011, in 2012 a vast 40% of the total waste from the Forum Building was paper and cardboard. Unfortunately, it was impossible to find out what quantity of the total paper waste could be ascribed to printing for academic purposes, nonetheless our interviews and observation of disposal boxes next to copying machines point the relevance.

1.2 Sustainable practices

As part of Wageningen UR, Green Office Wageningen (GOW) aspires to initiate change towards more sustainable practices within the institution. Therefore, we as project team from GOW[2] propose a strategy to make paper use for academic purposes at Wageningen UR more sustainable.

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[1] In this study, academic material is understood as printed readers, slides, articles, draft versions, assignments, courses guidelines etcetera that are used for educational purposes.
[2] For the purpose of this report, our research group will lead a fictitious pilot project for Green Office Wageningen (GOW). This organisation will be the ghost commissioner. We, as students, position ourselves as colleagues of the current GOW members.

Sustainable behaviour has generally been interpreted as the ability to continue the current practices without negative effects that could harm people and the environment, in another place and in the future. Within the context of unnecessary printing, we translate sustainable behaviour to the daily practices related to printing academic materials. Within this context, (un)sustainable printing is related to several practices embedded in the current system, for instance the digital availability of documents, recycling, the unrestricted number of printouts per person and double-sided printing. A change in these practices thus demands a transformation of the system, not merely individual behaviour.

A possible -more sustainable- solution for the printing behaviour of Wageningen UR students and staff can be found in the direction of Information and Communications Technologies (ICTs), which includes the Wageningen UR network that enables digital sharing and distribution of files, and the complementing hardware e.g. computers, laptops, tablets and e-readers.

Paperless office

The direction we take in the strategy that we propose is based on the idea of the paperless office. This assumes an office where little or no paper is used, as all work will be done electronically (Ramsurrun, 2012). To set up and run a paperless office, the organization needs to be committed to the process and invest in hardware such as computers, scanners and data storage equipment, network servers and periodic testing of the system to ensure its efficiency (Kodner & Cottam, 2006). Ramsurrun further states that the global demand for paper was expected to have exceeded 400 million tons for the first time in the year 2012. Without recycling, this equates to 7.2 billion trees. He observes that electronic filing has advantages such that it is easier to search and locate files, save files, distribute files among employees, and softcopy of files would be available to all users who are properly connected to an internet service or local area network.

The aim of this project is to increase the sustainability of printing operations at the Wageningen University. Therefore, we first made a stakeholder analysis. This was followed by the socio-technical analysis in order to gain insight in the system. On this basis, the main opportunities and barriers have been placed in the system analysis framework (Table 2). This has led to the development of a set of recommendations.

2. STAKEHOLDER ANALYSIS

In order to develop a strategy to improve the sustainability of printing practices at Wageningen UR, we described the stakeholders that are involved in printing for academic purposes.

2.1 Methods

The analysis was based on our own opinion as experts in the field; this was additionally confirmed by interviewing people from different categories of stakeholders. The sample was based on the objective to get a diverse picture of different interests and variety in behaviour among stakeholders. Brouwer, Groot Kormelinck and Van Vugt (2012) propose a tool to enumerate stakeholders and describe those using different variables as interests and stakes. Besides, we decided to analyse the characteristics of printing: whether it is done on their own initiative or demanded by someone else, and whether it is significant in terms of quantity or not. These will help us to highlight different behaviours and the relevance of the stakeholders.

Additionally, we analysed the level of influence and interest of every stakeholder in order to identify their role in a possible set of solutions, which were constructed also taking into account this analysis.

2.2 Analysis and results

Given that *students* at Wageningen UR are the biggest and most diverse group, we created four categories of students to stress differences: students who pay for printing at Wageningen UR (Bachelor students – BSc and Master students - MSc) and students that don't pay for printing (Doctorate students - PhD). Among these, we differentiated between students who print a lot and students that don't. This division is also related to the supposition that they probably are the one of the main stakeholders in terms of quantity, again because of their number.

Lecturers are also supposed to print a considerable amount; they print materials for meetings and presentations, for classes they teach, for reports, materials for reading, hardcopies for editing, documents for long-term storage, paper reminders for tasks needing completion, etc. They might print these documents because they don't like reading on computer screen or out of habit. In many cases, teachers don't print themselves but through their *secretaries*. It has to be stated that they don't have quantity restrictions to printing.

Green Office Wageningen and the *Student Council* are stakeholders deeply involved in sustainability issues and students' affairs, respectively. However, they have different roles. The Student Council, a body of students which represents the interests of the students at Wageningen UR, has the power to present initiatives to the Board of the University. GOW consists of Wageningen UR students who are concerned with sustainability issues. The organisation brings different stakeholders together to discuss sustainability, enable the exchange of information, reflect on the sustainability strategy of Wageningen UR and initiate projects for a sustainable university (About us, n.d.).

While the legal ownership of GOW has not been established yet, the organization is supported and supervised by the director of the Facilities and Services Unit. This department is set under the final

responsibility of the Executive Board of Wageningen UR. See Appendix A for a comprehensive depiction of the university's organisational structure. The university's ambition is to take a leading role in sustainable operational management (Sustainability, n.d.).

Regarding the administration of Wageningen UR, we consider that the *Executive Board* is the most powerful stakeholder in terms of decision making. It understood that the Audit Committee can also have an important role when it comes to advising the Executive Board regarding important recommendations. Additionally, the recommendations given by Green Office can be influential.

Printing suppliers may not be very important in terms of their printing attitude but they will be affected if there is a change in Wageningen UR's printing strategy, or if students change their printing behaviour.

To give an overview of what was exposed above, Table 1 next shows all the stakeholders previously described and their main features.

Table 1
Stakeholder Characteristics & Roles Matrix

STAKEHOLDERS	INTERESTS – STAKES IN THE MULTI STAKEHOLDER PROCESS	TYPE OF PRINTING
Bsc & Msc students who print low quantities	They limit their printing for 'practical' reasons Concern about the environment. They try to use of resources sustainably, they recycle Contribute to lower the impacts on the environment by making the effort of reading from the computer They have to pay for the prints at Wageningen UR	Voluntary (material for studying) Quantity: low significance
Bsc & Msc students who print high quantities	They consider printing as necessary for learning They don't think about their own behaviour as problematic They have to pay for the prints at Wageningen UR	Voluntary (material for studying) Quantity: highly significant
PhD students who print low quantities	They limit their printing for 'practical' reasons Concern about the environment. They try to use of resources sustainably, they recycle Contribute to lower the impacts on the environment by making the effort of reading from the computer They don't have to pay for the prints at Wageningen UR	Voluntary (material for studying) Demanded by supervisors (drafts versions) Quantity: low significance
PhD students who print high quantities	They consider printing as necessary for learning They don't think about their own behaviour as problematic They don't have to pay for the prints at Wageningen UR	Voluntary (material for studying) Demanded by supervisors (drafts versions) Quantity: highly significant

STAKEHOLDERS	INTERESTS – STAKES IN THE MULTI STAKEHOLDER PROCESS	TYPE OF PRINTING
Lecturers / Supervisors who print low quantities	They digitally send articles and other materials for students to read Their academic activities involve reading a lot They could be environmental conscious They don't pay for the prints at Wageningen UR	Voluntary (material for teaching, researching) Quantity: low significance
Lecturers / Supervisors who print high quantities	They spread printed articles and other materials for students to read Their academic activities involve reading a lot They are less environmental conscious They don't pay for the prints at Wageningen UR	Voluntary (material for teaching, researching) Quantity: highly significant
Supporting Staff (Secretaries)	They are generally in charge of printing for the lecturers Generally, they don't decide what and how to print (two sides, booklet versions, smaller fonts, etc.)	On demand by lecturers Quantity: highly significant
Executive Board	They are responsible for Wageningen UR Strategic plan 2011-2014. One of its goals is Sustainable operational management[3] Make Wageningen UR financially more efficient	Not relevant
Audit Committee	They suggest financial decisions to the Executive Board They know exactly the expenditure in printing	Not relevant
Facilities and Services	Contracts suppliers for various other general and technical support services, such as cleaning, catering and printing facilities They make suggestions to the Executive Board to improve practices and the use of resources	Not relevant
Green Office Wageningen	They make suggestions to the Executive Board and Facilities and Services to improve practices and the use of resources from a sustainability perspective	Not relevant
Student Council	It is a body of students which represents the interests of all students They have the power to influence (oppose) decisions that affect students	Not relevant
Printing supplies providers	They provide Wageningen UR with printing supplies	Not relevant

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[3] A sustainable image in research and education goes hand in hand with a sustainable approach to operational management. Wageningen UR aims to maintain a leading position in the field of sustainable operational management while applying proven technologies. This means that we deliberately choose not to use the most risky innovative solutions. Changes in the organization and in the attitude of the employees are required to make sustainability an inextricable part of our operations and daily practice. It is a long process, but one Wageningen UR is determined to realize. (Wageningen UR, 2011)

STAKEHOLDERS	INTERESTS – STAKES IN THE MULTI STAKEHOLDER PROCESS	TYPE OF PRINTING
	They don't want to reduce Wageningen UR consumption of printing items Some of them could be interested in using environmentally friendly supplies like recycled paper and soy ink	

Additionally, as part of the analysis, we assess the degree of influence and interest of the stakeholders in achieving a more sustainable academic printing practice at Wageningen UR, which is visualized in Figure 2. The purpose of the Figure is mainly visual: to show with different quadrants how the different stakeholders relate to each other. It shows that stakeholders who print less, and the ones who have most power within the structure of Wageningen UR, probably have a higher interest in more practical or (financially) efficient sustainable printing practices. Stakeholders who print a lot or who are not in charge of printing, are supposed to have less interest in sustainable printing practices.

However, because changes in the system towards more sustainable paper use demands a change in the current behaviour of stakeholders who print high quantities, attempts to change their practices could induce resistance. These stakeholders might start to exploit their power: if they do not agree with the change, they might actively object the recommendations. Nonetheless, as put in the previous paragraphs, different allocations can occur.
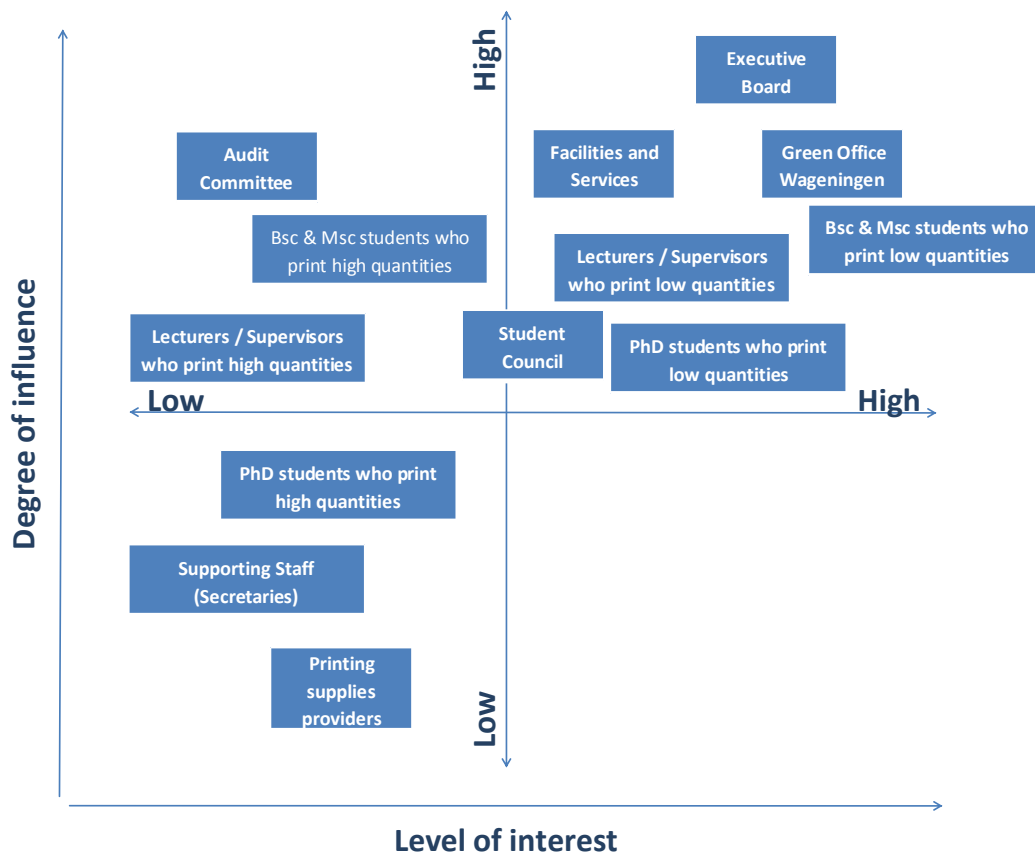
Figure 2   Stakeholders degree of influence and interests

In the next step of this proposal, the socio-technical analysis, we will use the most important stakeholders. The focus will be on the different types of students and staff among Wageningen UR in particular. The Student Council wasn't included since paper use is an individual decision: there is no collective action foreseen from students that could require or trigger the inclusion of the Student Council in the in-depth analysis. Improving sustainability in general is not something that is likely to be opposed. Additionally, according to the information gathered through interviews, printing supplies providers don't have a significant power in the paper use issue. They don't have long term contracts or any other kind of influence on decisions of Wageningen UR, which is why they will be not included in the socio-technical analysis.

3. SOCIO-TECHNICAL ANALYSIS

In this chapter, we will perform a more in depth socio-technical analysis in order to gain a better understanding of the barriers and opportunities to change paper use at Wageningen UR.

3.1 Methods

The system analysis framework, as described by Van Mierlo et al. (2010), is a suitable tool to analyse the different social and technical aspects of paper use at the Wageningen UR. The argumentation for this choice is that the system analysis framework provides insights into the factors and actors that hinder the transformation to a more sustainable system. Acquiring insight into the barriers seems very valuable in the case of the paper use at the Wageningen UR: several parties strive for a situation in which the Wageningen UR, in accordance with its general sustainability course, handles paper use (more) sustainable.

Even though there is already an existing infrastructure that could facilitate such a sustainable situation, there are certain elements that hinder this transformation. Thus: the system analysis framework could provide valuable insights into the social and technical barriers.

Based on this method, the most promising opportunities can be identified to enhance the transformation in a structured and coherent way. To do so, interviews with key subjects were conducted in order to establish the opportunities and barriers within the system. Two questions were the main guidelines during the system analysis:

- *Why is there still such a high (unsustainable) level of paper use at the Wageningen UR?*
- *What developments, internal or externally, are opportunities for the project to be a success?*

Additionally, we made an internal discussion to address those issues that weren't expressed during the interviews and to get a deeper analysis of specific topics which required a better understanding.
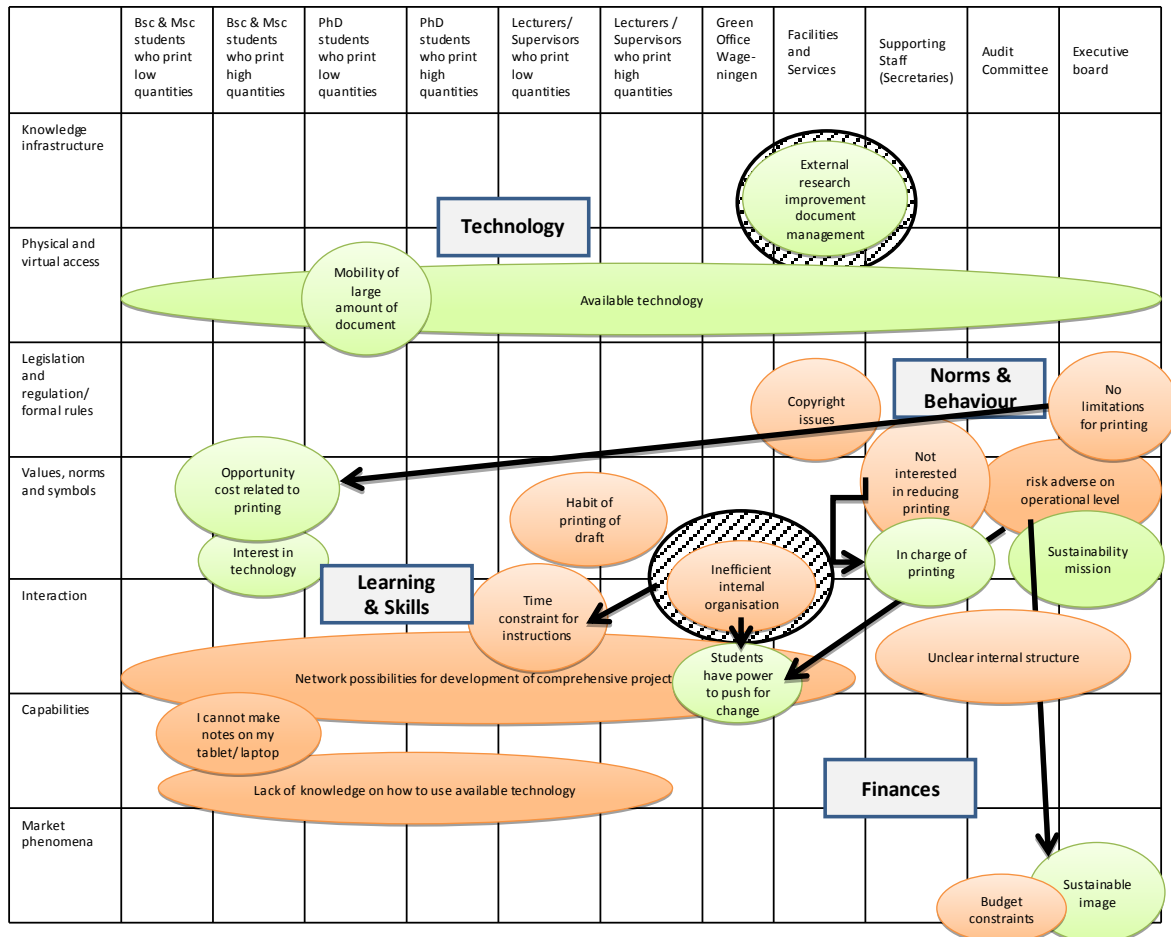
3.2 Analysis and results

To have a detailed understanding, we examined the stakeholders based on their role within the issue, given the different options that currently or in the foreseeable future avail to encourage sustainable paper use. These options include the use of e-readers, provision of 'rapid training' for both students and staff on flexibility around reading of 'softcopies' without printing, abolition of 'hardcopy' printout of university journals, among others.

Using the results of the interviews and the discussions, we constructed Table 2 which shows the opportunities and barriers related to 'bigger' subjects related to the sustainable paper use in Wageningen UR. In the table, green balloons represent opportunities, red balloons are barriers, and the main subjects are stated in white boxes. The cross-hatched balloons depict where there are already some activities present for improvement of a specific part in the system. A more in-depth description of the former is developed in the next step.

Table 2

System analysis framework – Barriers and opportunities in the current system

	Bsc & Msc students who print low quantities	Bsc & Msc students who print high quantities	PhD students who print low quantities	PhD students who print high quantities	Lecturers/ Supervisors who print low quantities	Lecturers / Supervisors who print high quantities	Green Office Wage-ningen	Facilities and Services	Supporting Staff (Secretaries)	Audit Committee	Executive board
Knowledge infrastructure								External research improvement document management			
Physical and virtual access		Mobility of large amount of document			Available technology						
Legislation and regulation/ formal rules							Copyright issues	**Norms & Behaviour**			No limitations for printing
Values, norms and symbols	Opportunity cost related to printing / Interest in technology		Habit of printing of draft				Not interested in reducing printing / In charge of printing	risk adverse on operational level / Sustainability mission			
Interaction	**Learning & Skills** / Network possibilities for development of comprehensive project	Time constraint for instructions	Inefficient internal organisation	Students have power to push for change		Unclear internal structure					
Capabilities	I cannot make notes on my tablet/laptop / Lack of knowledge on how to use available technology					**Finances**					
Market phenomena										Budget constraints / Sustainable image		

Technology

3.3 Main subjects, opportunities and barriers

From the analysis, we were able to group the results into four main subjects. Within and between each subject we observe opportunities, barriers and relations that we will further explain.

3.3.1 Technology

With the term 'technologies' we refer to different technological groups, e.g.: devices (such as computers, laptops and tablets), software (programs that enable you to process text or otherwise facilitate the comprehension of the text) and networks (such as internet and access to Blackboard).

The system analysis shows that the field of technology is an important cluster with regards to the (unsustainable) paper use at the Wageningen UR. From the system analysis it becomes clear that

technology is seen by the different stakeholders as a field that mainly offers opportunities that could facilitate the transformation to more sustainable paper practices, rather than hindering it.

What is also interesting to note is that the technology cluster is rather on 'its own' and has no relations within itself or to others clusters. This indicates that technologies offer independent opportunities to guide the transformation.

- **Opportunity: 'Mobility large amount of papers'.** As PhD students travel a lot**,** it is not convenient for them to drag piles of paper with them everywhere they go (personal conversation, November 22, 2013). However, they do need to be able to access their collection of journals with personal notes and highlighted parts wherever they are, without having to drag them with them physically. Thus, this provides a window of opportunity: the need for documents to be accessible anywhere (and thus: virtually stored) also provides opportunities for more sustainable (and more digital) paper use.

- **Opportunity: 'External research improvement document management'.** Gert Koerselman (interview, November 28, 2013[4]) is currently executing a research and developing a vision about improving the document management and logistics department at Wageningen UR, specifically about implementing a digital working environment. A positive side effect of the implementation of the digital working is that it has as 'a positive side effect when it comes to sustainability'; because more digital documents means less printed materials. The sustainable aspect of the digital working is also one of the pillars of his vision, therefore: his current actions are an opportunity for a transition to more sustainable paper practices.

- **Opportunity: 'Available technology'.** For all the involved stakeholders the existing technologies are seen as an important [window of] opportunity, as the current existing technologies already form an infrastructure that enable the system to make the transformation from printed paper to IT-based document use. The infrastructure is already present and could facilitate this transformation, even though it is currently not yet fully in use.

The different stakeholders refer to different groups of technologies that could facilitate such a system change. For example: Leo van der Heijden (interview, November 20, 2013) refers to software called 'Adobe Acrobat Pro' that should be made available for all students, as this program enables students to alter faulty pdf documents and thus: improve the reading experience and thereby decrease the need for printing such faulty files. Marta Eggers from GOW (interview, November 15, 2013) thinks that a system change should be guided by technology devices and thus she advocates the promotion of e-readers among students and staff.

3.3.2 Learning and skills

Learning and skills here refer to those knowledge deficits that account for students' interest to print, especially those who print large quantities. Learning here referring to the inability of students to update their knowledge of usage of the existing technologies, while skill refers to their acquired ability that comes in handy as they try to work on uploaded internet files.

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[4] A transcript of all interviews can be found in Appendix B.

- **Opportunity: cost related to printing.** The opportunity cost to printing is perhaps not enticing enough for the unsustainable student. The unsustainable student for instance attribute their willingness to print articles that pose a challenge to reading as most articles often posted on blackboard pose this challenge. For a typically 20 years old second year student, it is better to print an article and pay for it than to spend lots of time trying to rotate a page when transiting one page to another. With this category of students, an opportunity lies in the existing software such as the blackboard. Proper scanning and uploading of articles on blackboard could partly reduce printing habit of such students. The barrier to this category of students not reading electronically is due partly to deficit knowledge in pdf and other software, stating that it isn't unable to highlight, alter and make comments on pdf files, and therefore find it comfortable to print.

- **Opportunity: Interest in Technology.** The widespread use of computers and other smartphones already provides an opportunity to transform the current norm of printing out every article. This is however possible with proper upload of articles and short courses on understanding and using some technological resources as pdf format.

- **Barrier: Habit of Printing Draft.** It is the practise for supervisors of students' thesis to request hardcopy draft versions of documents occasionally and this provides a barrier to the sustainable student or environmentally considerate student who prefers not to print documents. This practise could be curtailed by lecturers using the existing technologies provided by the university.

3.3.3 Norms and values

The decision to print and not to print by students and staff is fostered by prevailing norms and values. The norms entail the predisposition of students to print given that printers are readily available with unrestricted quantities of print per student. In addition, students' decision to print hinges on perceived effects of such printouts on the environment. This is however, often not the main reason not to print, as the underlying reason is often attributable to cost reduction.

- **Opportunity: Sustainability Mission.** Another opportunity is the university's mission to pursue knowledge transfer in a sustainable academic environment. The university, capitalizing on this can gradually introduce smart courses on use of software's, enhance proper upload of articles by support staff. It is possible under the circumstances for the university to liaise with manufacturers of certain technologies like the e-readers, to provide such facilities at discounted prices to students.

- **Opportunity: Student Power.** To ensure the adoption of the innovation options being proposed, it is essential that students make use of the opportunity that avails to them. Students have the power to induce change by their habits and also by requesting the academic board to implement certain new practices if those practices represent the generality of student opinion.

- **Printing Decision (who is in charge).** The current norm of unlimited ability to print as long as a student is able and willing to pay poses a barrier to reducing the practice of printing. Given this practice, the opportunities that exist to curb uncontrolled printing habits include daily restrictions to pages printed per person, increasing the costs of printing per page to discourage the practice.

- **Barrier: Inefficient internal organization.** Given the inner structure and the organization of Wageningen UR, it became clear that the possibility to establish common agreements is quite low. It can also be related to the organizational culture, especially within the faculties (and even at a personal level); as they prefer to keep some of their administrative decisions to their own. GOW, though, has an intern working on the improvement of its internal organisation. The organisation lacks vigour which results in projects on sustainability that are not followed through.

- **Barrier: Copyright Issues.** It is understood that authors of articles that are uploaded on the blackboard would have to paid copyrights fees as these articles can easily be tracked. The avoidance of payment of these copyrights causes documents to be transferred through other forms, thereby encouraging the printing habit of some students.

3.3.4 Finances

From the framework it becomes clear that the cluster related to financial concerns is subjected only to the audit committee and the executive board. The audit committee is in charge of presenting the budget to Wageningen UR Executive Board in order to be approved.

Budget constraints are relevant for the university's executive board when faced with expenses related to alternatives to the current printing activities. Costs incurred with current activities must be weighed against the alternatives.

- **Barrier: Budget constraints.** When paper use at Wageningen UR is analysed, the main barrier to engage in innovative solutions is related to the budget constraints. Proposals that increase Wageningen UR costs will not make the cut unless they are very well stated in terms of future financial advantages for Wageningen UR.

- **Opportunity: Sustainable image.** Since some of the university's funding and existence is based on their sustainable image (Safety & Environment, 2012), the institution has a stake in developing further sustainable operations. Wageningen UR must push itself to compete with other universities for funding and students. This occurrence is a window of opportunity for changing the printing activities and staying on edge with their sustainable operations. A hindrance to this development would be the risk adverse attitude of the board towards their operational activities. According to Eggers (coordinator GOW) *"they are very on edge with research, but are conservative on operational level. They only want to change their operations when they are confident that it will work"* (interview, November 15, 2013).

As a final conclusion, we established that given the stakeholder and the system framework analysis, the subject of reducing paper from a system's perspective has a medium uncertainty because it's an issue that doesn't have many changes in to its application or perspective. This could lead to the construction of alternatives which can last and succeed through time.

However, when it comes to the level of agreement, it's quite clear that this is a situation that might hinder the possible solutions. Even if all stakeholders agree about the importance of the subject (actually, is there anyone who would say that environment is not important?), there aren't clear

messages, statements or shared objectives related to a paperless operation. This situation analysis is shown in Figure 3.
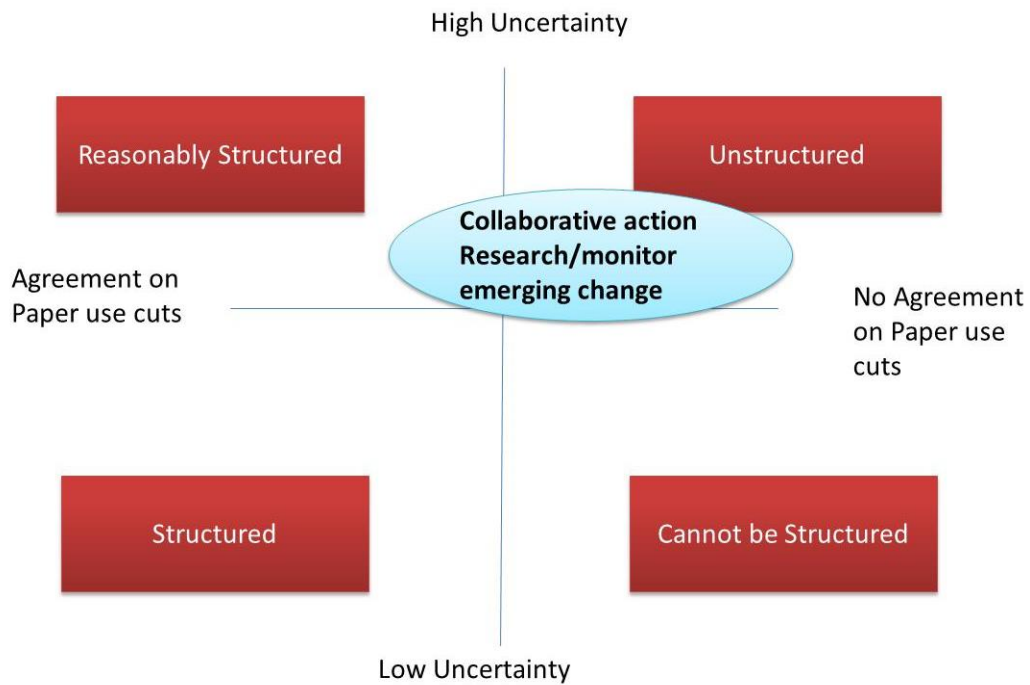
High Uncertainty

Reasonably Structured		Unstructured

Collaborative action
Research/monitor
emerging change

Agreement on
Paper use cuts

No Agreement
on Paper use
cuts

Structured		Cannot be Structured

Low Uncertainty

Figure 3　　　　Certainty and agreement analysis

4. PROCESS PLAN

Based on the stakeholder analysis (chapter 2) and the socio-technical analysis (chapter 3) in this fourth and final section of our proposal, recommendations will be made about the proceeding steps concerning the transformation to more sustainable paper practices at Wageningen UR. First, a framework is proposed to guide the progress on this subject. Within this framework, guidelines for action are suggested. These guidelines are organized according to the clusters identified during the system analysis.

4.1 Methods

As explained above, the current situation of the subject has a medium uncertainty and with no agreements about it. For this reason, we've decided to use Participatory Action Research (PAR) as the framework to construct the research process as shown in Figure 4, including a set of possible solutions. Pain, Whitman and Milledge (2010) describe PAR as a "*collaborative research, education and action used to gather information to use for change on social or environmental issues. It involves people who are concerned about or affected by an issue taking a leading role in producing and using knowledge about it.*" (p. 2). We consider that this framework will be important to build effective solutions with higher impacts, but especially, it will enable that all the stakeholders could establish a common base to create shared objectives and agreements.
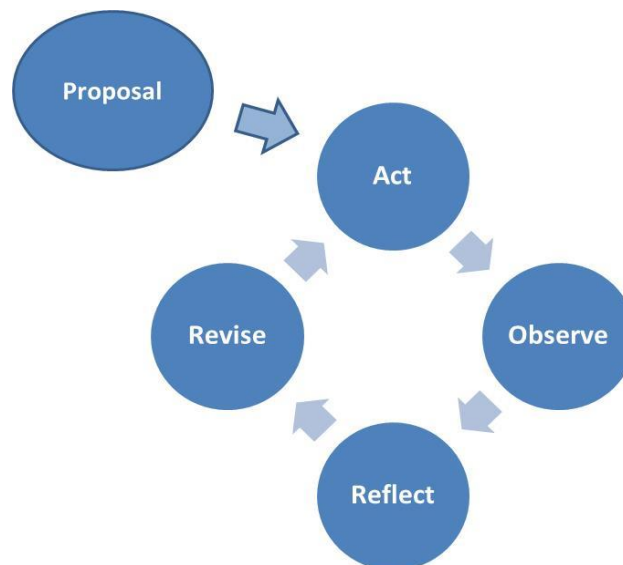

Figure 4   Iterative cycles of action research

Additionally, we consider that the Persona tool will be a key input to the process. A "persona" is a fictional description of the users involved in a product or process design. The goal of such a model is to make a clear, precise and vivid description of the actual users of the product or process (Gulliksen, Göransson, Boivie, Blomkvist, Persson, & Cajander, 2003). A persona describes the patterns that exist within the general user group concerning behaviour, goals and motives. This seems particularly interesting in the case of paper use at the Wageningen UR, as there are already existing alternatives to

printing paper. Thus, it seems to be a matter of goals and motives why people print or don't print sustainably.

4.2 Process and action lines

In order to establish a coherent process, we have defined four action lines, which are a direct response to the main subjects determined previously by the socio technical analysis. These lines were developed using the PAR design of iterative cycles of action research, as shown on Figure 4. As the concept of PAR states that each new iterative cycle corresponds to the results of the previous one, in this proposal we established the action lines in which this iterative cycles should develop. Then, each action line is described.

4.2.1 Technologies: Implementation of available alternative technologies

As became clear from the social-technical analysis, all the involved stakeholders see the current technological infrastructure as an opportunity to reduce printing behaviour. Therefore, we suggest the act of implementing a pilot project to monitor the success of replacing printed paper with the currently available technologies (e.g.: devices and software). The participants of the pilot project are students and educational staff. The participants will be actively selected: the most extreme 'cases' (non-printers versus big printers) will be invited to take part in the pilot project, to generate as diverse results as possible. Within the participant group the participants will be assigned to use different technologies: a distinction will be made between devices that enable you to read digitally (tablet, e-reader and laptop) and software that enables you to enhance the quality of the digital documents and a combination of both conditions.

The objectives of the pilot project are: (1) to generate insights in whether the target group would actually adopt the suggested alternatives and (2) if the proposed alternatives indeed lead to the objective of printing less. From the social-technical analysis it became clear that a major obstacle for a paperless Wageningen UR is the Executive Board: an organ that is rather conservative in making decisions, while they have - also in the case of paperless Wageningen UR – decision making power. This rigidness makes it unlikely that all recommendations will be implemented overnight. Therefore, the results of the pilot project will provide a base for the Executive Board to decide upon further action. Also, the active selection and 'tracking' of the participants of the pilot project makes it possible to execute an elaborate analysis of the target group. This could provide further insights in individual printing behaviours and habits, the reasons underlying this behaviour and the demographic and socio-cultural variables of the target group. Based on this analysis, differentiations can be made within the target group. This makes it possible to tailor the recommendations for implementing the measures in the whole Wageningen UR-society in such a way that the chances of succeeding are optimized.

4.2.2 Norms and behaviours: Persuasive communication campaign

When trying to alter a system, diverse type of actors from different levels are involved. The system change we are trying to facilitate involves a collective process. Leeuwis and Aarts (2011) explain further that "everyday communicative exchanges and self-organisation among societal agents are likely to be of critical significance in connection with the re-ordering of social relationships" (p. 21). While changes of the university's regulations are set at the higher levels of the institution, students are at the opposite spectrum actually engaged with the printing activities. When bringing forth advice that will bring about

change in the printing activities, those parties can be engaged in separate ways. Creating leverage at the students' level for adjustment that will support the changes made from above (executive board) can be useful. By making students talk about subject of printing, the topic becomes relevant and a basis will be set for accepting changes related to printing. Also, we could argue it the other way around. Making students think through their printing behaviour might be the cradle for new initiatives which, by creating a cultural turnaround, could effect Wageningen UR's decisions on the subject matter. The latter is in line with the findings of Leeuwis and Aarts (2011) that change should be facilitated by engaging in activities that enhance the success of the preferred type of initiatives over other initiatives.

We recommend fostering change within a subgroup of Wageningen UR's dynamic system by making students talk about printing and criticise their own actions. From our socio-technical analysis we were able to distinguish different groups of students whom we translated into diverging persona descriptions. The 'sustainable student' subgroup is already printing as few as possible and therefore do not need to be aimed in a persuasive communication campaign. On the contrary, we found that that the persona of 'paper waste student' is not thinking about the amount that it is printing. We cannot expect change from such students since their attitude towards printing correspond with their printing behaviour. With the cognitive dissonance theory (Aarts & Van Woerkum, 2008) it is explained that change in one's actions comes from a uncomfortable feeling one might feel when their behaviour and beliefs are contradictory. For the 'paper waste student' this theory implies that the student might reconsider its printing activities, only when new ideas cross its path that would make the student question its current attitude towards printing. Also, by engaging in such a communication campaign a larger support base is created for initiatives that promote the reduction of printing activities.

GOW, being a student organisation, would be a proper actor to create a stimulus among this subgroup of Wageningen UR students. We would like to propose that GOW could set up a communication campaign to make the subject of unnecessary printing relevant. According to Aarts and Van Woerkum (2008), the campaign's focus on reaching the 'paper waste student' will increase the binding power of the campaign with that specific subgroup (p. 51). An idea for such a campaign could be creation and distribution a caricature showing a student that is researching sustainability walking around with a big pile of paper. The contrast in the picture is meant to get students to talk about the issue of sustainable paper use. Since humour is an accessible medium, many students could be engaged with the caricature. Such a campaign would be a fun and creative way to make students question their way of working.

4.2.3 Learning and skills: Capacitation Process

As discussed in this document, printing habits by students and generally the university staff can largely be attributed to inadequate knowledge in the use of computer software such as Microsoft word, PDF, among others. Given the rapid transformations in computers, e-readers and other equipment, the library becomes a major contributor in this quest to reduce paper prints in Wageningen UR. Bosc and Harnad (2005) are of the opinion that academic libraries should be considered research tools, co-evolving with technology.

The Wageningen university could in this regard train, organize, or facilitate the training of staff and students to be able to carry out reading in an 'on-screen computer reading mode'. This training programme can be organized prior to the beginning of each period to sharpen the skills of users of academic regard in a manner that will enable on-screen manipulation of PDF files and other documents without printing them. Secretaries could also be trained in scanning procedures to limit errors in scan uploads, by this reducing the tendency for students to print articles because of improper scan uploads.

The library has a leading role in assisting the institution to run and maintain a status of paperless institution, and therefore entrench its position as a sustainable and environmentally friendly university. Costs of print-outs at the library could be increased, only after trainings on computer software have been duly incorporated in the university's set-up and sufficiently implemented.

Meanwhile, the library could be setting the pace for other libraries in the Netherlands by gradually reducing the stock of hardcopy books on its shelves and increasing electronic storage of data. Rapple, Euster, Perry and Schmidt (1997) observe that "a complete technological transformation resulting in a true virtual library where no human librarians or information specialists come into contact with the public is not yet nigh for most institutions" (p. 47). This is possible, if the entire student body is extremely literate. However, it also poses the question of the ultimate desirability of the university, as a virtual library has social and economic implications on library staff.

4.2.4 Finances: Recommendations for the Executive Board

From the analysis, various topics can be translated into options that would contribute to sustainable printing practices. Some of these options can only be implemented by the executive board of Wageningen University, as they have most power (in certain areas) to facilitate change. This power can shape boundaries for printing activities of students and staff.

The unlimited amount of printing by PhD students and staff could for instance be reduced in order to make them think before they print and only print what they need (so not all earlier mail conversations). In addition to this, a system could be introduced (similar to phones) that when exceeding the limit, every extra printout will cost them money.

For students who have to pay the prints themselves, a monetary discouragement could be in place. Then, printing a lot would be very costly, and more easily outweigh the investment needed for alternative (paperless) reading solutions, e.g. the e-reader or tablet. Any profit made from the proposed actions could be invested in initiatives that increase sustainable practices at Wageningen University.

These recommendations do not provide harsh boundaries to printing, but make printing a less attractive option and so reduce (unnecessary) printing. However, without an attractive or equal alternative, behaviours are unlikely to change. Therefore, alternatives for reading printed documents could be derived from the idea of the paperless office. Providing portable devices on which people can read, like tablets or e-readers, could be managed by the Facilities and Services department

5. DISCUSSION OF LIMITATIONS

5.1 The opportunity and barrier analysis and the process plan

When we started with our research into the topic of reducing unnecessary printing at the university, we expected to unravel a clear cut organisational structure of Wageningen UR. While we did find an organisational chart, the power structures and the channels through which change could be brought about remained puzzling.

External researcher Gert Koerselman (interview, November 28, 2013) confirmed our finding by adding that Wageningen UR consists of different self-organised departments. This decentralised system gives the departments autonomy and at the same time makes the diffusion of top-down regulations harder.

This confusion limits the ways in which we set up our recommended acts. Meaning, that we formed our acts in the process plan from the limited knowledge we had about the internal structures of Wageningen UR.

Another important limitation within our analysis are the number of actors that we were able to interview. For our socio-technical analysis a collective analysis was set up that was supposed to be supplemented by all the actors. With our limited time we were only able to interview three people from GOW and Facilities and Services.

The input for all the other actors we thought of ourselves, with the knowledge we had from our previous analysis complemented with information we received about these actors from the interviews. This method might have led to incomplete results. The framework of the socio-technical analysis assumes that all parties agree on the problem at hand. In our case, everyone should have to agree that printing activities are problematic.

Since we did not have all the actors actually engage in the analysis, we cannot be sure that assumption would hold. We do believe, however, that by using this framework we were able to identify key opportunities and barriers in the system.

APPENDIX A

Organisational structure of Wageningen UR
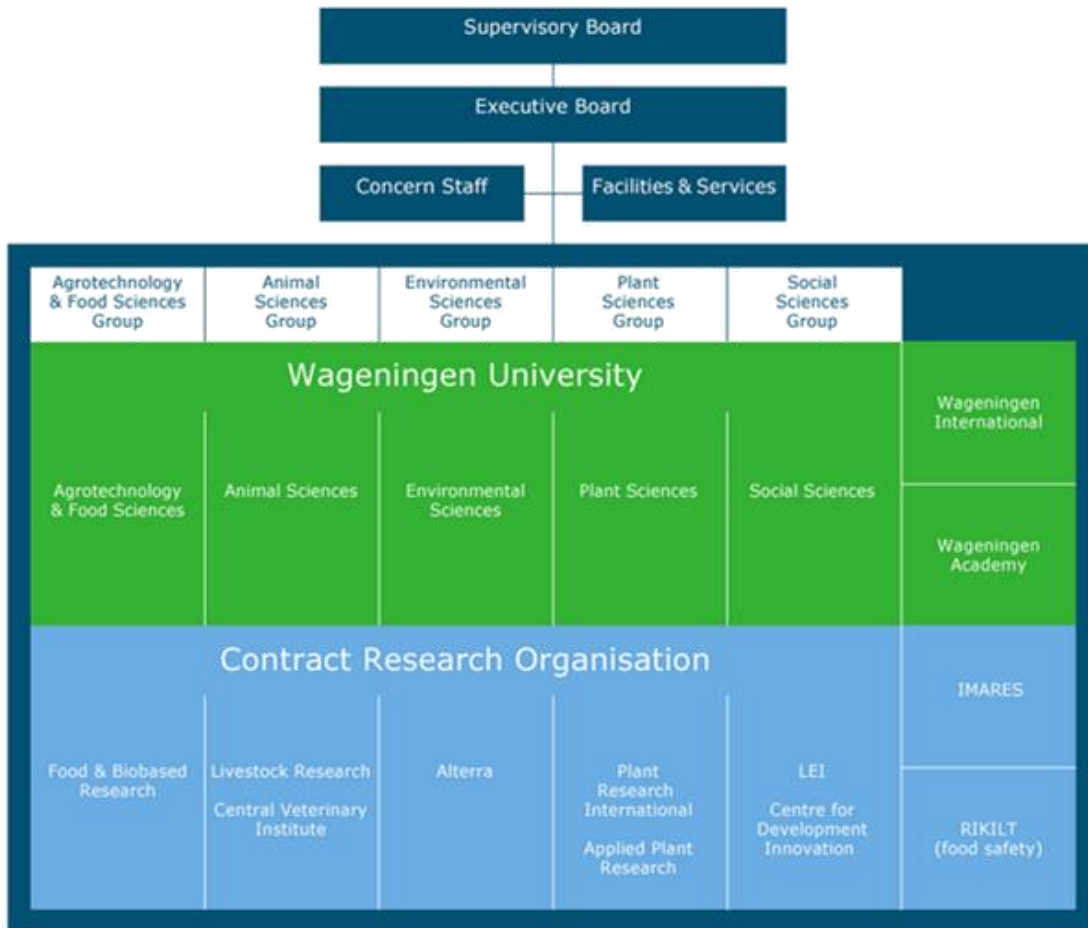
APPENDIX B [5]

Actor interviews

- **GOW** (Marta Eggers – coordinator)
  Date: November 15th, 2013

Eggers idea to reduce printing by introducing e-readers is being shut down every time she brings it up. She could not convince the other members, because she does not have a well-rounded plan and argumentation. That is caused by the lack of time she and GOW have to do research. The coordinator works 16 hrs/week, the 5 other members together put in 16 hrs/week in total. That makes 3 or 4 hours for those members each week. Since GOW a new organisation, they need to figure out how to work efficiently. An intern is assigned to investigate how GOW could work more efficiently. From the interview we conclude that an important barrier is inefficient internal organisation. The next challenge would be the formation of an elaborate network within Wageningen UR from which projects can develop.

As project managers we added the following barrier to the framework on basis of the interview: Conservative culture of Wageningen UR. According to Eggers "they are very on edge with research, but are conservative on operational level. They only want to change their operations when they are confident that it will work".

- **Facilities and Services** (Leo van der Heijden – responsible for purchasing)
  Date: November 20th, 2013

He is passionate about reducing the use of paper at Wageningen UR.

Leo explained that the main barrier would be the lack of knowledge on using the available technology, for reading documents digitally. People are stuck on the way they read documents like articles. Confronted with the option to read digital documents, some complain that they cannot underline words or make notes or that the articles in pdf are not scanned in properly by the staff. He proposes that the library department could set up workshops that would show all the options for reading digital documents. Another idea is making a program called Adobe Acrobat Pro available for students. With this software students can alter faulty pdf documents, so that they can improve their digital reading experience and decrease the need for printing such files. An opportunity would be for students (like GOW) to organize themselves to change the practices of the university. As a staff member sometimes his ideas are not taken seriously. Leo feels that students, being the customers of Wageningen UR, have the power to push for change.

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[5] This appendix consists of short summaries of the interviews we had with the different involved stakeholders. Much was discussed during the interviews, but in the summaries only a short reflection on the information relevant for the system analysis is given.

As project managers we added the following opportunity to the framework on basis of the interview: The opportunity of cutting costs. The university could stop the printing of study handbooks, their Resource magazine and Wageningen World magazine. For the latter the readers have recently received a letters asking them if they would like to switch to the digital version.

- **Facility and Services** (Gert Koerselman – Document Manager)

Date: November 28th, 2013

Gert Koerselman is recently hired to reorganize the document management and logistics department of the Wageningen UR. An important aspect is the transition to the digital era, which has as a positive side effect more sustainable paper use (because: more is digitalized). He thinks a major obstacle is the anarchistic culture of the Wageningen UR; every faculty can decide upon itself, but no one says: you have to do it. No formal decisions are made at the Executive Board level. But: the already existing ICT/ system environment is very well equipped and ready to facilitate this digitalization.

As Facility Services, Document Manager we added the following barrier to the framework on basis of the interview: The unclear power structures and internal structure at the Wageningen UR.

Also: the reorganization Gert Koerselman is guiding and his current actions are an opportunity, as digital working involves less paper printing and is more sustainable, moreover because sustainability is one of the pillars of his vision.

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