

The Personal Assessment Tool: An experiment

**Jutta Willamowski, Yves Hoppenot, Christelle Loiodice, Antonietta Grasso,
Victor Ciriza**

*Xerox Research Centre Europe, 6, ch. de Maupertuis, 38240 Meylan, France,
firstname.lastname@xrce.xerox.com*

Abstract: We present the Personal Assessment Tool (PAT) aiming at making users aware of the impact of their behavior on the environment and helping them to reduce it. PAT targets print behavior in a corporate work environment. We have deployed PAT in our research center and describe this experiment along with preliminary findings and observations. From these findings we conclude that PAT definitely motivated the participating users to improve their print behavior. Nevertheless it also highlighted the constrained aspects of printing in a work environment calling for organizational changes of established work processes.

Keywords: Awareness, eco-feedback, behavior change, print behavior

1 INTRODUCTION

To face global warming issues and in general to promote sustainable development, many tools have been developed that help people to assess the impact of their behavior on the environment. These tools are often referred to as CO₂ calculators. They collect input about user habits and behaviors, either dynamically in the background or as explicit input from the user, and provide as output a measure of how much they affect the environment, translating these behaviors into units like CO₂ and energy consumption levels. Such tools are becoming widespread and their overall aim is to provide awareness, educate the user, and ultimately change this behavior in order to reduce his impact on the environment. Despite their simple mechanism, these tools are, however, very challenging to design in such a way to provide incentive to change habits and use of resources.

Froehlich et al. [2010] discuss the design of eco-feedback technology and various factors motivating pro-environmental behavior, namely information, goal-setting, comparison, commitment, rewards / penalties, and feedback. They emphasize the influence of these factors as follows: Information about the individual's behavior and the impact of behaviors on the environment provides a first level of awareness and motivation. To be effective this information must be presented appropriately, i.e. easy to understand and at the right time and place. Setting goals allows driving attention and efforts towards these goals. Commitment to goals can further motivate people to reach them. Comparison against peers and over time makes people more ambitious, trying to improve on others or previous results. As in other domains rewards can additionally incite people to adopt better behavior whereas penalties might inhibit bad behavior. Feedback plays a central role: indeed all the above mentioned factors rely on corresponding feedback (allowing for instance appreciating how close one is to reaching a goal). Without appropriate feedback the user's motivation may drop quickly. It is therefore important to carefully think about the content, the frequency and the way feedback is provided to users. Borst [2010] provides further insight on different aspects of motivation, namely intrinsic versus extrinsic motivation, and the impact of rewards on user's behavior.

In the light of these studies we have designed the Personal Assessment Tool (PAT) to make users aware of their impact on the environment and to help them to reduce it [Grasso et al. 2010]. PAT targets print behavior in a corporate work environment. Section two presents PAT highlighting at the same time those characteristics of the system that implement the motivational factors discussed above. Additionally to those an essential component is the *permanent awareness and feedback* provided to the user. To support green transportation habits, Froehlich et al. [2009] choose a mobile phone display as appropriate way to provide permanent feedback to the user. To address print behavior, in PAT we choose a widget sitting permanently on the user's screen. In November 2011 we have deployed PAT in our research center; section three presents this experiment along with preliminary findings and observations. From these findings we conclude that users were overall motivated to improve their print behavior. Nevertheless the work context imposes constraints that make it sometimes difficult to achieve a substantial change.

2 THE PERSONAL ASSESSMENT TOOL

The Personal Assessment Tool (PAT) aims at making users in their work context aware of their impact on the environment and at helping them to reduce it. The PAT server intercepts user actions in the background, analyzes them and provides its users through the PAT client with feedback about their behavior, the evolution of their behavior over time and how their behavior compares to that of their colleagues. In the current version PAT addresses only printing but the aim is to monitor also other user actions, impacting for instance office energy consumption. The PAT client comes as a widget permanently sitting on the user's desktop. It displays a flower losing its petals over time thus materializing the user's impact on the environment (Figure 1). Following a user's print action this flower is updated close to real time and provides thus permanent high-level and up-to-date feedback to the user.



Figure 1: PAT widget.

To determine the user's impact on the environment the PAT server computes a cost for each action in terms of a virtual currency called Green Points (GPs). Concerning printing the impact on the environment is mainly determined by the print volume, i.e. the number of sheets consumed. The *basic cost* of a print job is thus proportional to the number of sheets printed. The printing cost formula adds furthermore *penalty costs* for particular environmentally unfriendly behaviors such as single instead of double sided printing, repeated printing of the same document, and printing document types that should typically not be printed (such as Email, or PowerPoint presentations). The GP cost is thus not directly proportional to the impact of an action on the environment but emphasizes furthermore particular bad habits.

When users install the PAT widget and register they first go through a self-assessment step with questions about their printing habits in order to make them reflect about their behavior and to motivate them to improve. In this self-assessment users are asked to estimate first the number of sheets they typically consume in an average week, and second the distribution of their print jobs according to particular characteristics (single versus double sided printing, short versus long documents, types of documents printed). In the self-assessment result

their answers are then confronted with reality, i.e. the user's observed behavior, to provide an initial motivating Aha! Effect (Figure 2).



Figure 2: Self-assessment, questionnaire excerpt and result.

Based on the user's observed past behavior, the PAT server computes the user's mean monthly consumption. At the beginning of each month, it allocates the corresponding personalized GPs quota of the user. With each print action the user then consumes some of these GPs. The widget connects regularly to the PAT server to update the displayed user status in nearly real-time: The number in the center of the widget (cf. Figure 1) indicates the amount of GPs remaining for the current months whereas the proportion of remaining leaves represents the proportion of remaining GPs with respect to the user's allocated quota.

If a user exceeds her quota, this does not prevent her from printing. Indeed the idea is *not to force* the user to print less *but to make* her aware of her impact and *motivate* her to reduce it. On the opposite, if, at the end of the month, the user did not consume all her allocated green points, PAT will save the rest for her. Over time changing and improving print behavior will thus materialize as saved GPs.

To help users understand and improve their behavior, the PAT widget allows them to examine their print actions in detail through the expanded digest view (Figure 3). This view enables users to look at their actions from different angles (cost in GPs, number of actions, i.e. print jobs issued, and volume, i.e. paper sheets consumed). The digest view provides information about the user's current status, his personalized quota and his savings accumulated over the past months.

In the digest view three graphs give access to more detailed information about the user's consumption: On the top left a first graph displays this consumption over the last few months making trends visible. On the top right a second graph shows a break down over relevant categories for the current / selected month. These categories correspond to the print job characteristics taken into account in the cost formula (single versus double sided printing, repeated printing of the same document, types of documents printed). The display distinguishes basic and penalty costs (blue for basic, hatched in red for penalty cost). This allows the user to understand where his consumption went and where and what he can do to reduce it.

In the lower part, a third graph displays the detailed consumption per day or month within the current month or year. Clicking on the corresponding point in time gives the user access to information about the jobs she issued including the document title, cost and length. This third graph also allows the user to compare his individual consumption with the mean consumption of the colleagues belonging to the same group and understand if he is rather average, outstanding or the black sheep in that community.

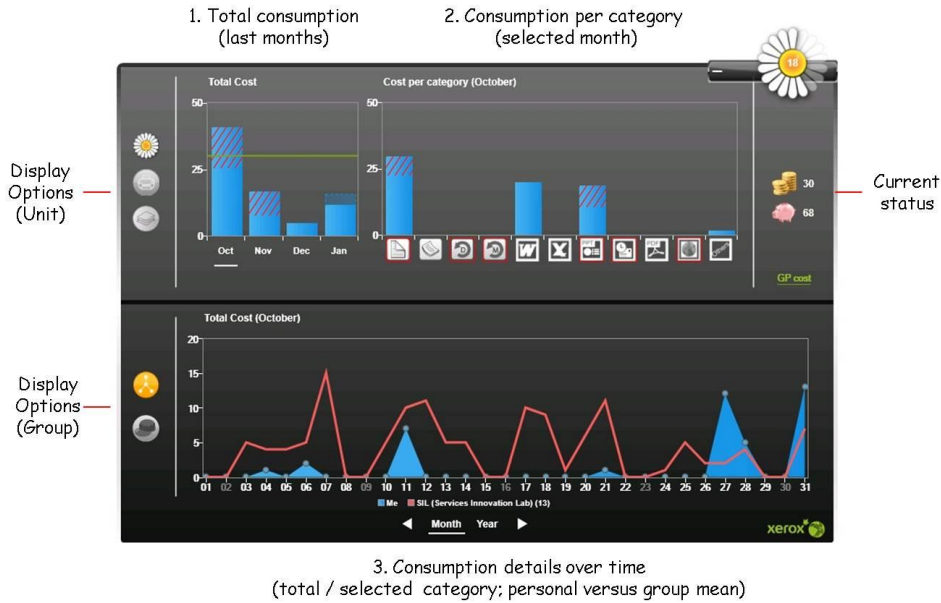


Figure 3: PAT widget with expanded digest view.

PAT addresses printing in a work context. Global information about the consumption and its evolution over time on the corporate or organization level is accessible through the PAT web portal, again in terms of cost in GPs, print jobs issued, and sheets consumed (Figure 4). The portal provides further information about the total savings achieved within the organization and about the current employee engagement (number of employees participating, distribution of participants over the various organizational groups and work roles).

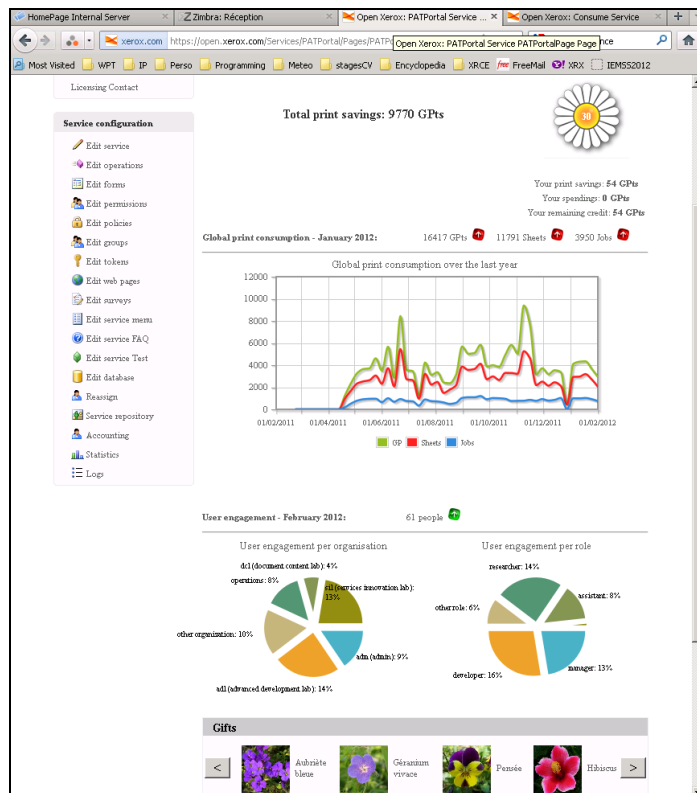


Figure 4: PAT corporate portal.

The portal will also enable the corporation to prove its engagement in the environmental issue by publishing corporate actions for the environment (planting trees for instance). Indeed employees might be reluctant to participate in corporate actions if they feel that these are in reality motivated only by financial savings. It is actually often the case that economic considerations are “disguised” as environmental behaviour. The portal will show the corporation’s definite commitment to the environment. It will enable employees to exchange their personal savings for corporate green gifts or to invest them into the proposed corporate environmental actions.

3 THE EXPERIMENT

We have deployed PAT in our research center in November 2011 starting with a short center-wide introductory presentation and providing support whenever asked for. Over 50 people, i.e. more than half of the eligible employees registered within the first month on a voluntary basis. They were distributed over the different labs composing the research center on the one hand and the various work roles (researcher, developer, manager, assistant etc.) on the other hand.

During the (still ongoing) trial period, we collected feedback on various occasions either spontaneously at any time or when assisting a user with the installation process. First of all, the self-assessment step proved to be effective. Indeed, several users reported that they had no idea of their printing consumption and habits and had difficulties estimating those. The self-assessment result confronting them with their past observed print behavior incited those users to immediately open the digest view to have a deeper look at their behavior. Several users (re-)discovered some particular (huge) print jobs they had recently issued and forgotten. Some of these print jobs concerned furthermore personal documents which is not a problem in this experiment setting, where it is accepted that work and personal life are often interleaved, still it helps to make people aware of their personal usage of common (work) resources.

Having registered, right after the self-assessment, several users spontaneously shared and commented their personal quota through the PAT web site. This created somehow a sense of common objectives that could also be leveraged for other organizational activities and goals.

With the PAT flower widget sitting permanently on their desktop a number of users reported they felt it put a strong pressure on them inciting them to think twice before issuing any print job. One user even forwarded this pressure to the person replacing him during holidays by putting a post it on his screen urging to “print only what is really required”. Some others reported that they sometimes wanted to close or uninstall the widget in order to get rid of this pressure particularly when they felt that the current (bad) status shown by the flower widget was not their fault, i.e. they had only printed what was required by their job but it had been an exceptionally high volume this time due to some unusual tasks.

Another person wanted to uninstall PAT, because her print consumption did not reflect her own working style but that of her boss traveling a lot and requiring her therefore to print lots of material to take away at such occasions. She was not only concerned about the way her personal behavior was impacted, but furthermore afraid that this would put bad light on her whole group when the results of the experiment would be presented to everyone. As discussed also by [Sellen 2003] it is indeed important to recognize that printing and working with paper documents is not always something the individual can fully control but rather depends a lot on the job requirements and context.

Several users pointed out particular work processes in place in the center that are based on paper rather than on digital documents and which they have to follow which in turn makes them lose their personal GPs. Among these processes many are imposed by the organization and cannot be changed by the individual, sometimes also due to legal issues like intellectual property, accounting etc. People asked if these processes could be changed or the corresponding

documents recognized as required by the organization (and not by them personally) such that the corresponding GPs would not be withdrawn from their personal account.

Some other work processes correspond rather to individual work habits and could be improved after reflection. One person for instance, responsible for a particular process, learned to digitally sign the forms she had to handle in order to get rid of printing intermediate paper documents just for signing purposes. Another person responsible for ordering supplies had previously archived a printed version of the order before sending it for signature. After reflection she decided that finally keeping the digital version only was enough.

To reduce their print consumption several users reported they moved towards more digital competency, reading on screen instead of paper, and scanning through a document before deciding if it is worth printing and which pages are relevant. One user even reported that she now furthermore digitally annotates the papers she is reading and actually likes this working style.

To reduce reprinting of huge documents one person proposed to share such documents once printed within her group. Such document sharing promotes good work practices and fosters communities at the work place. Some users reported that they did not reprint documents to get rid of minor formatting problems as they did before the experiment. For instance they did not reprint an Excel document where - in the print out - the last column had moved to the next page, due to a last minute change.

A part of the center's print consumption was also due to contact with external visitors and partners. In this context some PAT user's work consists of taking care of these visitors and providing them with documentation and promotional material. This is difficult to change because it involves not only the organization itself and its image but also the external partners and their expectations. To be able to reduce corresponding printing needs it will be necessary to relate the change in behavior (providing less printed material) convincingly to the general environmental benefit (instead for instance to corporate financial savings) such that external partners accept and adhere to this change (similar to towel reuse in hotels as discussed by Goldstein et al. [2009]).

PAT also brought issues to the surface where users reacted inappropriately (and may be thought existing software would solve the problem for them): indeed, when a printer blocked or broke down, users with a job in the corresponding queue often did not cancel that job but rather re-sent it to another printer. Nevertheless, when the initial printer got repaired, the queued jobs were printed and the corresponding GPs removed from the user's accounts. PAT made them aware of this problem and incited them to remember canceling jobs when appropriate.

Overall most users reported that they liked the tool and were interested in the environmental issue (which is not surprising as the participation in the experiment was on a voluntary basis and users who did not buy in did not participate from the beginning). Some participants reported an evolution of their attitude towards the tool over time: in the beginning they somehow over-reacted (trying to completely stop printing); then, over time, they changed and adopted a reasonable attitude, printing what is necessary, but trying to reduce and improve where possible. One user reported that a longer period of time is needed to learn various strategies for better printing (for instance to avoid having only one line of text on the last page of a document). She also would have liked additional functionality allowing her to set up personal objectives and follow their achievement.

Finally the experiment also highlighted some usability issues: sometimes users have their desktop filled with applications and corresponding windows. In these cases, the PAT widget is covered and not visible.

Beside the qualitative results presented above, we are currently analyzing the data collected before and throughout the experiment, in particular the user's print job logs on one hand (starting from May 2011, i.e. 6 months before the start of the experiment), and the PAT server access logs on the other hand providing information about the usage of the widget over time including the details about when people opened the digest view and which information they accessed.

The analysis of the PAT usage log provides us with information about if and how people use the PAT widget and its features and which information they essentially look for. A first analysis of these data shows that the number of users connected during work hours was rather stable over time which mainly indicates that users had the widget on their screens continuously (i.e. did not uninstall PAT). The access and usage of the digest view varies a lot. Indeed, while most users accessed the digest view on the day they registered, only a few consulted it regularly afterwards. We still need to analyze if there is a link between opening the digest view to access particular information and changing behavior.

With our experiment we primarily focused at a qualitative analysis that provided the results described above. Even if the quantitative analysis of the print volume in terms of number of sheets consumed before and after the experiment start date shows that the overall consumption has decreased, and that this decrease was more important for PAT users than for other employees, the current observations do not allow concluding with sufficient confidence that this reduction was achieved thanks to the PAT system. This is due to the limited number of employees in the center on one hand and to the limited observation period (well below one year) on the other hand.

4 CONCLUSION

In this paper we have presented PAT, a tool that makes people aware of their print behavior in a work context. We are currently conducting an experiment of this system in our research center. Overall the feedback collected from the experiment indicates that users got well engaged with the tool, i.e. that the way PAT implements the eco-motivational factors works. The way PAT presents information and provides feedback about his print behavior to its user first during the self-assessment and second on a high level through the flower and on a more detailed level through the digest view seems to be useful.

The PAT users were overall motivated to improve their print behavior from the start, participation in the experiment being optional. The feedback collected shows that PAT helped its users to move towards better print behavior: indeed several people got aware of particular bad work processes they owned, found how to improve them and in consequence changed their behavior. Nevertheless as described in the previous section, the work environment often imposes constraints on individuals that make it difficult for them to achieve a substantial change. PAT incited these employees to pinpoint processes in the organization where changes can bring substantial benefit. In order to enable further improvement, the organization has to react and adapt its processes moving from paper to digital and ultimately to the paper-free office as described in AIIM [2012].

Making employees point out problematic processes is something that existing commercial tools aiming at optimizing printing in work environments will have more difficulty to achieve. Such tools usually target more the administrative side and provide end users only with punctual intervention rather than permanent awareness and feedback. [GreenPrint] for instance assists its user *when submitting a print job* first proposing to remove irrelevant content before printing and second advising on appropriate printers and print options. [Preo Printelligence] allows administrators to define rules to trigger “unobtrusive notifications” that will be shown to end users in particular situations e.g. to inform them about the cost of their last print job or to propose them to learn about particular features.

After all it is still an open question how users will react to a tool like PAT over a longer period of time. Will people get used to the tool and will the impact thus decrease? To maintain and increase motivation, we plan to introduce gaming mechanisms into the system: defining and proposing performance levels, challenges and competitions to users, allowing them to define and bet on (i.e. commit to) individual or collective improvement targets can contribute to keep them motivated over time. It will make people talk about the tool and their common objectives and also enable them to find and share strategies to reduce their

consumption and to identify organizational processes that should be changed. Displaying the information about the global consumption in the shared printer area as proposed by Pousman et al. [2008] is another possibility to trigger discussions. Finally, to come back to our experiment, this experiment had the particularity that users participated on a voluntary basis. It would be interesting to carry out further experiments in contexts where participation is non-voluntary.

REFERENCES

- AiIM, The paper free office – dream or reality, <http://www.aiim.org/Research/Industry-Watch/Paper-Free-Capture-2012>, February 06, 2012.
- Borst, I., Understanding Crowdsourcing, Effects of motivation and rewards on participation and performance in voluntary online activities, PhD thesis, Erasmus Universiteit Rotterdam, ISBN 978-90-5892-262-5, 2010.
- Froehlich J., Dillahunt, T., Klasnja P., Mankoff J., Consolvo S., Harrison B., James Landay, J. A., UbiGreen: Investigating a Mobile Tool for Tracking and Supporting Green Transportation Habits, paper presented at ACM Conference on Human Factors in Computing Systems CHI2009, Boston, MA, USA, April 4 - 9, 2009
- Froehlich, J., Findlater L., Landay, J., The design of Eco-Feedback Technology. paper presented at the ACM Conference on Human Factors in Computing Systems (CHI 2010), Atlanta, USA, April, 10-15, 2010.
- Goldstein, N. J., Cialdini, R. B., Griskevicius, V. A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels, *Journal of Consumer Research*, 35, August 2009.
- Grasso, A., Willamowski, J., Ciriza, V., Hoppenot, Y. A System Providing Environmental Feedback to Users of Shared Printers for Providing Environmental Feedback, paper presented at the Ninth International Conference on Machine Learning and Applications (ICMLA 2010), Washington, USA, December 12–14, 2010.
- GreenPrint <http://www.printgreener.com/>
- Pousman, Z., Rouzati, H., Stasko, J., Imprint, a Community Visualization of Printer Data: Designing for Open-ended Engagement on Sustainability, paper presented at Computer Supported Cooperative Work Conference (CSCW 2008), San Diego, USA, November, 8-12, 2008.
- Preo Printelligence: <http://www.preosoftware.com/>
- Sellen, A., Harper R. H. R., The Myth of the Paperless Office, MIT Press Cambridge, 245 pp., 2003.