DIGITIZING SHORT-TERM PLANNING:
A CASE STUDY OF BENEFITS AND COSTS OF APHEX PLANNER

Written in June 2021 by Carolina Toczycka, PhD candidate at the University of Edinburgh, for CVB JV (Tideway East), following the Digital Benefits Toolkit methodology.*
Full calculations are available in the complimentary Tracker for Aphex Planner.

Aphex Planner has confirmed the expected usefulness in terms of tracking progress and managing change, even if the format sometimes fails to engage as well as the traditional, more physical methods of planning. Still, Aphex Planner provided excellent value for money and even exceeded expectations by giving resilience in the sudden shift to work from home under the COVID-19 pandemic. It has also contributed to commercial assurance, including reaching the true position on subcontractor accounts, thanks to the structured, continuously recorded and diligently preserved data on progress. **It is expected to generate close to £1.1m in benefits over its lifetime from 2019 to 2023.**

1. DIGITIZATION PROJECT SET-UP & APHEX FEATURES

Collaborative planning wasn't adopted in a standardized way across the five CVB sites. When the opportunity to have an online short-term planning solution was identified in Aphex Planner, a trial period for one of the sites was accepted in 2019. Following the success of this trial, the implementation was rolled out across all five sites and the cost of the Aphex licence now stands at £25k per year for an unlimited number of users.

The features allow teams on complex sites with many interfaces, to:

- Create a detailed breakdown of short-term activities (those in the upcoming 12 weeks) by:
  - Site areas
  - Clash identification, by activity time and space, using the space-proofing, on the Aphex map view
  - Resource, across defined site zones
- Understand and investigate delays:
  - Consistent recording of delay reasons, as anytime an activity is pushed back a textbox demands the input, offering no way to avoid this
  - Analysis of the delay reasons (e.g. supplier delay, weather conditions, lack of consent or overcrowding) as well as the total length of delay

Aphex Planner aims for the digitalization of short to medium term planning (3 to 12 weeks), between others, allowing teams to align with key (and even intermediate) dates. Although the project has overall key dates, site teams focus more on each site's key and ambitious dates, as well as intermediate milestones. These aren't always aligned to the contract dates. The planners agreed with the PM to make intermediate milestones more visible (even if only 2-3 months ahead) and Aphex is helping with that. When used in the 3-week lookaheads, Aphex supports the foremen in knowing their needs in staff, and the engineers in knowing the needs in materials and in preparation of RAMS as well as the prioritization of activities between each other.

The software is cloud-based and accessible from the browser of any device, and by implication, always live. Unlike in MS Project, it is impossible for a user to work on two different programme versions simultaneously, since Aphex doesn't support editable off-line versions. While this approach affords a continuous synchronization, scenario testing is also limited as the activities cannot be shifted without making an immediate change to what others see.

Its relative simplicity is a strength; it is easy to set up clear, concise programme targets that are then visible to the wider team which allows for greater communication. ***(See end of case study for views in Aphex Planner)***

SCORING THE SYSTEM AND THE INFORMATION QUALITY (1 – LOW, 3 – AVERAGE, 5 – EXCELLENT)

System quality		Information quality	
Ease of use	4	Timeliness	3
Ease of learning	3	Usability	4
Integration	4	Understandability	4
Customization for CVB	4	Relevance	3
Sophistication	3	Conciseness	3
Flexibility	3	Format (for extracting)	4
		Accuracy	3
		Availability when needed	5
Sum (/30 max)	**21**	Sum (/40 max)	**29**

2. PATTERNS OF ADOPTION ACROSS SITES: SOURCES OF VARIABILITY

The adoption of Aphex differed across sites, depending on the projects' phases, and the site teams leading at particular moments in time. Aphex was found to not be particularly suited for small activities, and a balance had to be struck in order not to spend too much time inputting data relative to the duration of the activity itself. The differences are accounted for in the benefit calculations *(cf the Inputs tab of the Tracker for details)*. Differences were seen in the degree of subcontractor involvement in the platform use, the number of disciplines involved as well as the deployment in relationship to other planning tools *(such as post-its, MS Project, 4D BIM etc.)*. Other differences were observed in the degree of preparation required ahead of a meeting, the involvement of junior engineers, and the degree of interactivity during the 3-week lookahead meetings.

The TOTEM *(initially only on Phoenix Wharf, but across three sites as of July 2021, and initially introduced to increase the access to 4D BIM models)* was supportive of the greater use of Aphex Planner. While the plans were used predominantly in weekly 3-week lookahead planning held in site offices, the large interface was more reliable than a mobile, hand-sized device.

As of May 2021, the project teams and Aphex achieved the long-awaited **integration of the Aphex programme into Synchro 4D,** effectively removing the time lost on maintaining the previously different programmes; one for Aphex, and one for 4D purposes. This will significantly streamline the way Aphex and 4D work together.

Newer Aphex Planner versions also include suggestions of where an activity could be shifted to optimize the sequence of activities, which expects to further increase the perceived attractivity of the software.

Aphex Planner in use on Site

In terms of wider Aphex features, the clash detection and WBS codes features aren't yet used as they weren't available when the system was being set-up initially.

LIFETIME ACTUAL BENEFITS PROFILE (2019 - 2023)

			Man hours	Man days
Lifetime benefits	**£**	**1,138,951**	22779	2847
Lifetime cost	**£**	**149,000**	2980	372.5
Net benefits	**£**	**989,951**	19799	2475
COST/BENEFIT RATIO		**7.6**		

OPPORTUNITY GAP (AGAINST TARGET BENEFITS)

			Man hours	Man days
Late adoption gap	**£**	**925,924**	18518	2315
Partial adoption gap	**£**	**191,924**	3838	480

The opportunity gaps represent the benefits that
(1) could have been accrued had the digitization been implemented earlier (late adoption gap, in the period 2015-2020) or
(2) to a fuller extent (partial adoption gap, in the period 2020-2023)

3. KEY LESSONS AND FUTURE OPPORTUNITIES

- As of June 2021, just **over £800k of benefits are estimated to have accrued to CVB as the result of the Aphex Planner** implementation. Notably, close to a third of all benefits are financial (representing real cost savings, rather than efficiency) and the cost/benefit ratio stands strong at 7.6. An additional £925k of benefits could have been captured had the digitization occurred in 2015, rather than four years into the projects in 2019 (see "late adoption gap" indicator).

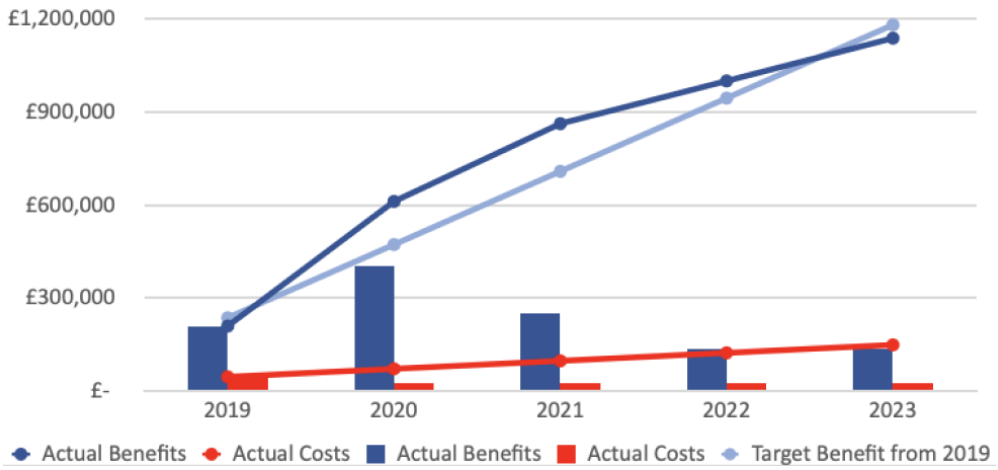
- Overall, the digitization with Aphex Planner has exceeded expectations, in part due to the role it played during the COVID-19 pandemic in **minimising loss of productivity days**. More effects of structured, uniform, programme progress data availability can be captured if the delay reason analysis is further pursued and acted upon.

- Of the £250m that CVB JV has planned to spend on subcontract accounts, commercial precedent shows that £10m will be related to claims. The granularity and consistency of data regarding work planned and delivered, helps ensure the correct answer is reached for these claims. The commercial team estimated that **Aphex facilitated the avoidance of additional cost of up to 5%, amounting to £500,000 over the project lifetime**.

- The extent of Aphex Planner use varied between sites, teams, and project activities, with adjustments made to accommodate for the learning period and the attachment to pre-existing forms of planning. **There is value in keeping a local approach in deciding how exactly to embed the software into planning processes**, rather than imposing a uniform approach, which potentially leads to excluding some stakeholders uncomfortable with visual Gantt formats.

LATE ADOPTION GAP

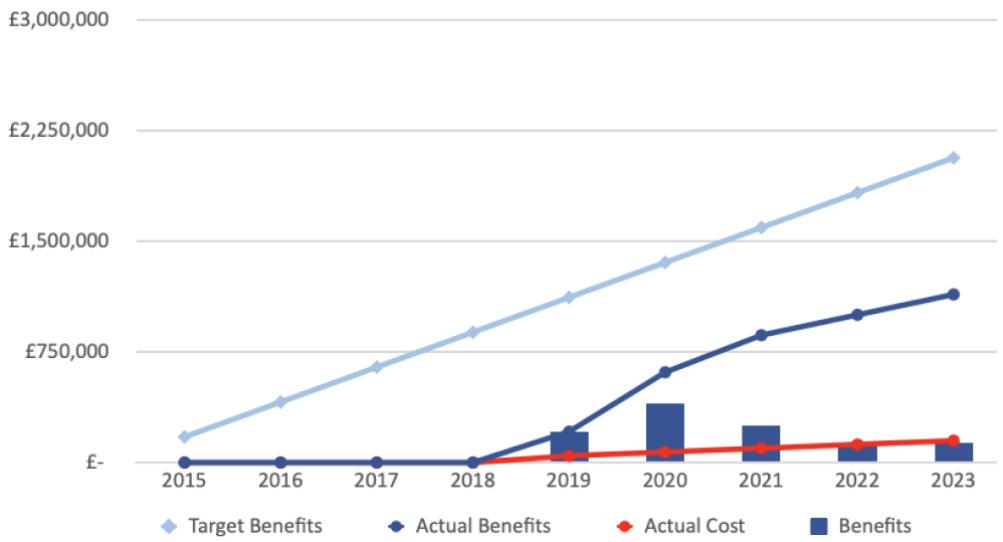
APHEX PLANNER CUMULATIVE COSTS AND BENEFITS (2019–2023) AGAINST TARGET BENEFITS (FROM 2015)



The surge in Actual Benefits in year 2020 is due to the success in the compensation event (captured as the "Increased commercial assurance" benefit 5 worth £500k). Equally, the resilience that Aphex Planner enabled for the project continuation under COVID-19, smoothening the transition towards a hybrid Work From Home, is accounted for: we have assumed, discounted under a 90% optimism bias, that the continuous recording of data and building of the capability to work from the online system culminated in a smooth transition not losing 2 weeks of productivity (benefit 4). **The resulting £200k efficiency benefit** represents the cost of finding, acquiring, and learning a new system from scratch in reaction to the sudden lockdown.

PARTIAL ADOPTION GAP

APHEX PLANNER CUMULATIVE COSTS AND BENEFITS (2019–2023) AGAINST TARGET BENEFITS (FROM 2019)



4. DEEP DIVE INTO THE SPECIFIC BENEFITS

BENEFIT 1: INCREASED EFFICIENCY OF PLANNING ACTIVITIES

Based on project participant's judgement and researcher's observations, it was found that the weekly planning was often trending towards half an hour (against the previous one full hour). Where up to fifteen people could be partaking in the immediate meeting or its overflows (such as follow-ups for clarifications), Aphex Planner is credit with enabling meetings to be run more efficiently, generating expected to generate over £167k in efficiency gains (Benefit 1).

Aside from monetisable gains, a behavioural, 'responsibilising' aspect is also recognized. The need to load the programme into Aphex Planner ahead of the weekly meeting has distributed (decentralized) and strengthened the personal responsibility for works. Engineers now need to prepare the plan ahead of the meeting – it does take another 30-60 minutes of their time, but it is the type of planning activity that should they should already be undertaking, and overall leads to a greater ownership of the planning task. This additional accountability (enabled by the overlay option which shows a line underneath each activity, setting a baseline to see if there is gain or slippage week on week) also creates the right mindset of readiness to capture opportunities for time saving.

As one of the project managers put it,

"The tools should be about communication to understand the problematic, to keep responsibilizing people on site, and rather than us becoming pixels and experts of virtual construction."

Aphex Planner was found to support the logic of "build it twice": out of a concern for time, cost, and safety. There is evidence Aphex contributed to reducing travel time between sites. Where some roles require presence across sites and it was found that Aphex was reducing the need to be physically present. Combined to the traditional "pick up the phone and ask" habits, the Aphex Planner is effectively reducing the number of trips one needs to make to "see for oneself" as the data available online is deemed sufficient.

But equally, a warning against overreliance on technology to identify clashes was formulated:

"What if we lose the ability to do construction, isn't it a risk for the profession not to be able to identify clashes with the bare eye?"

This reinforces the need to study the long-term unintended consequences of digitization, whether positive or negative, beyond the project timeline.

BENEFIT 2 – REDUCTION IN REACTION ACTIVITIES

Reaction time (colloquially understood as "putting out fires") refers to the time spent accommodating last-minute requests that could have been avoided with better planning, coordination and communication. This benefit is premised on the assumption that digital tools enable a better allocation of engineering time, which is also one of the Digital aims ("Freeing up engineer's time").

At the level of information systems studies, researchers agree to the potential of reducing reaction time, specifically noting Vaughan et al. (2013)[1] showing digitalization can yield weekly reductions of 1.5h of clerical time and 4h reduction in reaction time.

Reduction in reaction time is a consequence of the right people being notified at the right time – the information arriving promptly to the right person and the participants down the line not having to accommodate last-minute requests.

Caution must be exercised when arguing for the contribution of specific digital solutions to project level outcomes – the "reaction time" benefits cannot be directly observed in the timeframe of the present study, but can instead be deduced from academic literature on similar projects and comparable information systems, such as Vaughan et al. (2013). We apply a high optimism bias and a high attribution bias to signal that Aphex is only partially responsible for the effect. In the case of Aphex -75% because 4D BIM and digitized forms would have also all contributed.

We find that given the number of engineers involved (adjusted for the contribution of other tools to the effect as well as accounting for uneven patterns of use across sites and time), **this efficiency benefit stands at just over £170k.** This is a proxy of the time that could have been saved, but fails to represent the subsequent positive effects on the quality of other processes adjacent to the activity of the engineers (e.g. procurement, with reduction in materials waste or plant hiring time). To stay on the conservative side of estimations we haven't monetized the second order effects, although academic literature points at the significant opportunity to tackle re-work (as high as a 1/5 of all project cost), which is itself a consequence of poor planning and coordination (the root problem addressed by between others like Aphex Planner).

BENEFIT 3 – REDUCED INFORMATION RETRIEVAL TIME

Besides serving engineers in their daily information needs, Aphex Planner also helps the planners who now benefit from a uniformity of information format across the project. Although the information was previously available, the unique format and location makes it easier for the planning team to draw information for the overall project programme, including preparing the programme for acceptance.

Furthermore, a delay categorization was attempted to have an even richer basis of information, with over 80 delays reasons defined and imported to be selected from since every delayed activity on the Aphex Planner prompted an assignation of reason. However, it was then found that Flowforma site diaries (see the Flowforma case study) were a better tool to capture that delay information. This switch is accounted for in the attribution of the effect to other tools.

On a weekly basis, it was estimated Aphex Planner saves approximately 4-5 hours a week by removing the need to chase people or update programmes based on partial information. The efficiency benefit of "reduced information retrieval time" has therefore been estimated to over £16k.

BENEFIT TYPE BY £ VALUE

[1] Vaughan, J. L., Leming, M. L., Liu, M., & Jaselskis, E. (2013). Cost-benefit analysis of construction information management system implementation: Case study. Journal of Construction Engineering and Management, 139(4), 445–455.

5. PRESERVING THE ATTENTION SPANS

Aphex came to complement the traditional planning tools, including the post-its, and printed plans of the excel. The tool's user interface, specifically the small sized views are a stark change from the large post-it format that most foremen and supervisors are used to. Aside from being sometimes hard to decipher, the digital planning format has been accused of failing to generate the same engagement that a physical format does. The focalization on one point (the projected screen) with little or no physical movement throughout the meeting (replacing the warmly referred to "post-it dance") are possible causes for an increased difficulty of readability.

"A simple activity line in a project schedule is not always a sufficient picture to wake up the whole team." *One project participant noted*

The digital system has smart prompts and an overlayed nature in a way that interdependencies are more visible, comparable to another always-attentive participant is in the room to point as possible points of failure. One participant describes it as:

"COVID made it "no choice" not to use Aphex, however there are now people as watchers rather than participants. Before, they had no choice but to take a sticker, a post-it and place it. Now observers aren't seeing the clash, they aren't as attentive or tuned in".

We note that some find digital planning less engaging, with a decrease in attention given the Gantt-based interface. However, the younger generations are placing value on the renewed excitement connected to implementing the innovation – the "newness" of the tool itself brings the excitement and reinvigorates the search for optimization opportunities which would not necessarily be there with the traditional format. Beyond pure utility towards the direct task of organizing, innovation and change is needed to sustain the passion of delivering – and the mindset will be different at the frontline (conservative attitude) and the office (progressive attitude).

The physical board, although more static, has been found by some to be *"less quickly wrong"* than the digital version. It is made immediately present on the walls as one casually passes by, and therefore readily available for revision, rather than requiring the explicit effort of opening the platform on a PC, carving out screen space amongst other open windows.

One doesn't necessarily need to choose between the structured, digital format and data readability for everyone: Deptford have managed to secure the best of both worlds through a hybrid post-it/Aphex use, which ensures no one is left behind (post-its, physical exercise) while capturing the benefits of having an up-to-date programme tracked against a baseline. Equally, the coordination for more confined spaces such as STP is still better handled by the 4D BIM model updates rather than by the site layout within Aphex Planner

Another compromise that has been found and enabled by TOTEM was to upload a photo of the physical board onto the relevant Teams channel upon any changes made. In that way, the strength of the physical space is preserved without compromising on the timeliness and availability of information.

DIGITAL PRIORITIES MET WITH APHEX

6. COLLABORATING WITH YOUNG COMPANIES SUCH AS APHEX

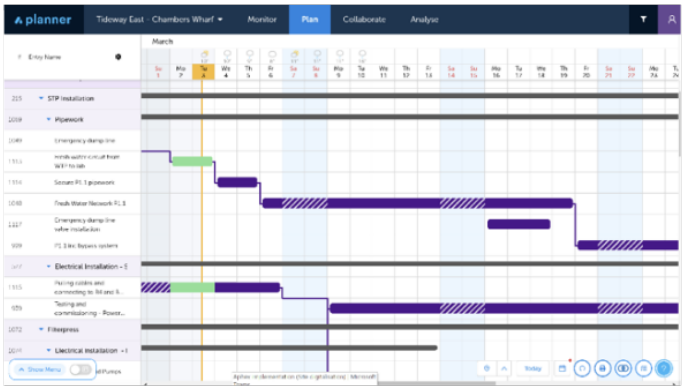
The cost of choosing a young company such as Aphex might be the additional time spent on fixing bugs or sending feedback to the development team. However, any inconvenience is outweighed by the flexibility such a company exhibits in tailoring the software to meet the requests of the site team.

"We would ask for a feature, they would take a few months and integrate – it is as if the entire software is designed on order for us [CVB JV] really."

"The Bentleys & Autodesks of this world innovate on what they think the industry wants while Aphex works because it was designed for the construction industry, by the construction industry."

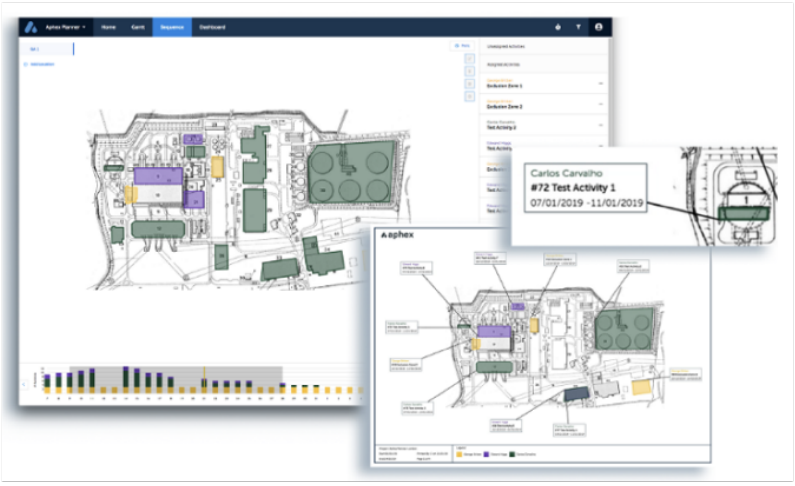
With a communication between the innovation champion and the software provider every two months, CVB JV has benefited from early transfers to new data analytics functionality as well as achieved to agree an export of activities from the Planner to Synchro, significantly streamlining the generation of up-to-date 4D BIM models for an even better understanding of sequencing.

REFERENCES – APHEX IN 2019



View of the programme in APHEX Planner

Delay reasons analysis in APHEX Planner



View of the site plan in APHEX Planner

ABOUT THE AUTHOR

CAROLINA TOCZYCKA

Carolina Toczycka is an EPSRC and Costain-sponsored PhD candidate at the University of Edinburgh. She studies the justification and implementation of digitisation costs and benefits on major infrastructure projects.

Carolina takes an interdisciplinary approach to conceptualizing what “efficiency” and “progress" mean for settings characterised by high uncertainty, complexity, and ambiguity in the digital age. She can be reached on Linkedin

RESOURCES

The Digital Benefits Toolkit was developed by the research partnership, and is available on request by contacting Jeremy Galpin (Jeremy.Galpin@costain.com) or Chloe Haynes (chloe@aphex.co)

For more information on the Tideway Super Sewer Project please revert to the official comms via the website.

For more information on Aphex, Aphex Planner, and the updates since the research was undertaken, please reach out to Chloe Haynes (chloe@aphex.co)

IN COLLABORATION WITH

Tideway

THE UNIVERSITY of EDINBURGH

COSTAIN

VINCI CONSTRUCTION GRANDS PROJETS

BACHY SOLETANCHE