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LEARNING FROM MOVIE-SETS COORDINATION

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ABSTRACT

A comparative study of large, professional movie sets and construction sites revealed that conditions for movie production were far more complex and unpredictable, with sudden surprises, changing facilities and often hundreds of people from independent professional groups to be coordinated from hour to hour at different locations (Egebjerg, 2012). These are the uncertain production conditions that we usually hear of as an excuse for not being able to control construction sites. Yet the study also shows that the movie industry is far better at controlling production time, budget and quality exactly as initially planned (Deloitte, 2010). Part of the explanation for this different performance is a process management system that large movie studios have developed over the years including a digital tool for micro-managing the process in a flexible way to suit the dynamic processes. Both industries live with the reality of obstacles occurring on the 'critical path' and the process becoming not as fast as anticipated. So there is a need for a map of alternative 'short cuts' to get back on track. Usually this work is managed inside the head of a professional construction manager, but even the best person in the job can become tired from keeping a high level of overview, information and coordination of escalating problem chains. This paper describes the innovative experiment of designing and testing on construction professionals a proto-version of a similar digital tool and system to that used on movie sets for detailed scheduling, coordinating and micro-managing construction processes. The current working name for this digital tool is "Short Cut", and it is seen as a future supplement to common scheduling tools with application for project parts that are particularly sensitive to deadlines or other complexities.

Keywords: coordination, flexibility, micro-scheduling, proactivity, process-manager

INTRODUCTION: CAN MOVIES INSPIRE CONSTRUCTION?

Movie sets are in many ways similar to construction sites (Egebjerg 2012) in that they involve:

- many different, independent professional groups having to collaborate with new people on the set every day, many of whom they have never met before and will never meet again
- timing is crucial, as is logistics, coordination, communication, etc.
- production facilities change while production moves forward at constantly - changing locations
- unpredictable conditions and everyday deviations from the plans
- fixed production plans have to be followed strictly or the consequences for the overall project will be severe

It only takes one small mistake to trigger an escalating problem-chain on a construction site, possibly leading to loss of money, loss of quality, accidents, conflicts, etc. (ex. Apelgren 2004, Seppänen 2009). This reality is very close to the

daily reality of large professional movie sets: Imagine any minor breakdown in the production plans for shooting a car chase through a city, or a sick main actor in a scheduled scene with rented animal trainers, child actors, weather dependencies, hundreds of extras, fitting production into special effects design, lots of permissions signed on a far away location rented only for the day, etc. All in all production breakdowns are just business as usual and has to be as well anticipated as possible in the pre-production phase. Movie set production management faces hundreds of production issues that do not turn out as expected and has only a few minutes for decision making on the spot on shoots easily costing one million dollars per day on a professional studio project. In movie production the unexpected is the norm. That is why movie managers through history have had to teach themselves to be Jedi masters of production management. They developed their own system, today known as the Hollywood studio management system, which is used across the world (ex. Brown 2006, Persse 2008).

At the centre of this management system is a scheduling tool different to all the common scheduling tools we know from construction sites (Gantt, Line of Balance, Last Planner System, Network Diagrams, etc.). It is more similar to a mixture of all these and a common meeting calendar where activities can be easily moved around. The aim of movie set management is to optimise the workflows in dynamic production processes through flexibility when plans are put into reality. The unwritten philosophy behind this system is close to the concepts about realistic, running plans that we also know from LPS and Lean Construction (ex. Ballard and Howell 1994, Koskela and Howell 2002), only these are even more detailed and proactive tools. This research study has designed and tested a tool for scheduling construction activities inspired from the principles behind the tool to micro-coordinate a movie set.

Movie sets are on time and budget while construction sites overrun

Egebjerg (2012) collected and analysed present industry statistics in Denmark and compared movie with construction performance looking in isolation at production costs, schedules and expected outcome. These figures showed an overall picture of movies performing far better than construction in reaching their plans and goals. In a large survey for the Danish Film Institute, Deloitte (2010) concludes that the movie industry is cost-efficient, finding that it goes 3% under budget in average, and points to the general Production Management System as the main reason for this success. Numerous interviews in Denmark and US with industry professionals confirm this picture (Egebjerg, 2012).

Endless reports about the construction industry in Denmark and abroad point out the poor performance of the industry in not keeping budget, schedules or quality with very random variations (5-30% on budget overruns) (ex. Byggeriets Evaluerings Center 2006-2009, Erhvervs- og Byggestyrelsen 2004-2009, Rambøll 2010, Rigsrevisionen 2009). One official study of time overruns on all construction projects finds an average of 17% on all reported productions in Denmark (Byggeriets Evaluerings Center 2009). Many of these industry analyses point to poor site management as one important factor (and the figures take into account as much as possible the influence of changes in the project during the process).

It is important to remember that these industry statistics are about production phases and are isolated from the overall financing of the projects. Movies tend to keep on budget during production, independent of later sales, which can vary with many times the production budget or end up in a big loss (ex. Bart 1999, Squire 2004). (Movie

projects have a very complex market and project financing, but the actual shooting financing is quite simple and isolated from the rest).

There are a number of different factors in movie production culture that should be mentioned: the professional client, the preproduction phase, the micro-scheduling tool, the open partnering process with sub-contractors during preproduction, contracts specifying process services, the ultra-lean micro-management (from minute to minute), the flow-manager (1.AD), the quality service coordinator (the Scriptor), the vertical dialogue, the consensus hierarchy from the producer/director teamwork distributing mutual respect and motivation down the line, the bonuses, credits, royalties etc. (Egebjerg 2012).

The statistics from construction management also disclose this large element of chance in which factors will eventually lead to an overrun, suggesting that typical management systems are very vulnerable to even small coincidences leading to escalating problem chains of accelerating complexity due to today's technologies (Seppänen 2009). Field studies by Egebjerg (2012) showed a significant case study of this element of coincidence leading to severe consequences on a construction site, beginning with a dispute over a 10 centimetre mis-measurement that had to be worked around, leading to more and more mis-coordination between the professional groups, daily ad-hoc changes to the schedule, demotivation and in the end, large overruns on time, quality and budget.

Field studies from movie sets (Bechky 2006, Egebjerg, 2012) showed how their management system catches the unforeseen events again and again within minutes and hours, stepping into immediate action to prevent further damage. They can do so partly because the digital scheduling tool supports minor adjustments and full overview of upcoming challenges to the flow of the production processes, and because the management organisation is constructed so that this information is always up-to-date.

Movie production industry has a secret weapon in the eye of the storm. One actor in the network holds everything together: the time schedule. This actor is non-human, but built inside it lies all the power of previous phases of careful planning, thinking and decisions made by many parties. It is a fluid entity (Latour 1991) that changes from inside the minute it hits production, but without ever changing the outside frames of deadlines and budgets (Egebjerg 2012). It is a flexible, dynamic schedule that everybody refers to during every minute of production; it is always in the pocket of every team member and never out of sight or ear in the walkie-talkies and the megaphone of the process-manager (1.AD). There is a great deal of respect for this digital tool that ties everything together to give a better overview, communication and understanding for one part of the whole, a trust that something is actually able to keep a hold on the chaos.

This is why this Postdoc research continued to study the principles behind this specific movie tool – trying to design a similar tool for micro-coordinating construction sites. The similarity lies not in the software, but in the idea of how a schedule should work with flow.

METHOD: SNOOPING BEHIND THE SCENES

The process of designing the scheduling software was based on knowledge gained from research during PhD studies: ethnographic studies at both movies sets and construction sites, literature studies, courses in movie business and scheduling software plus app. 50 semi-qualitative interviews with all levels of professionals from

both industries analysed in an Actor Network Theory perspective. These ethnographic studies of movie productions were focusing on large, professional feature productions to enable better comparative studies with large construction sites. This would mean: a professional client organisation (studio productions rather than independent), no changes in script/plans during process (feature rather than television), and large budgets (\$80-100m (US), large teams (2-300+ employed), independent supplier companies (contracts). Also did the author have personal experience from working several years as a professional in both businesses, movie industry and construction management (Egebjerg 2012).

Designing and field-testing the software has been done in prescription driven design science in close collaboration with future users as an agile development of new management instrument to control site processes (ex. Aken 2004, Holmström, Ketokivi and Hameri 2009, Lukka 2003). Designing version 1.0 has been done in collaboration with several user groups from the Danish construction industry and with IT experts from the field. Field-testing the prototype software in a minor scale has been done in collaboration with a large, Danish contractor (NCC) on an actual site. An easy user-interface has been a major priority of the design, so the idea of the test was to provide the construction site with these easy-read and always updated day-plans, week-plans, resource-plans, supplier-plans etc. for a better overview and communication. Secondly the field-test was able to provide site managers with the easy overviews of potential clashes (location, workspace, resources, logistics, weather bindings, noise issues etc.) and of course potential short cuts to the critical path. All this is done to observe if user-groups will pick up the idea to use the scheduling tool with all of its advantages of proactive coordination, but also to learn about things to improve for a later version 2.0. There has also been testing on usergroups from large North-American contractor companies – site managers and lean managers have demoed the software off-site and responded to it in interviews.

RESULTS: RESPECTING PLANS BY TRUSTING PLANS

Movie management system before the digitalisation would cover full walls with complex post-it plans similar to what lean-construction is doing today in their early phases, only far more detailed (scheduling production flow down to hours and minutes). Besides they are still drawing storyboards to visualise details in the product (scenes and shooting-angles) for easier communication in between the team, and mix this information in to the Work Break Down sheets where needed.

So much effort is put into scheduling the production processes that it makes the final result very durable for later discussions, but also more flexible for adjustments, because all details are written down and at hand. The trust of an intelligent schedule plays a significant role in the respect to the process through the team that is so profound in the culture of movie production. The schedule also plays a role as a social tool during the process – a tool for visual communication about logistics and coordination between many different professional suppliers.

Synchronicity needs as much precision as Asynchronicity

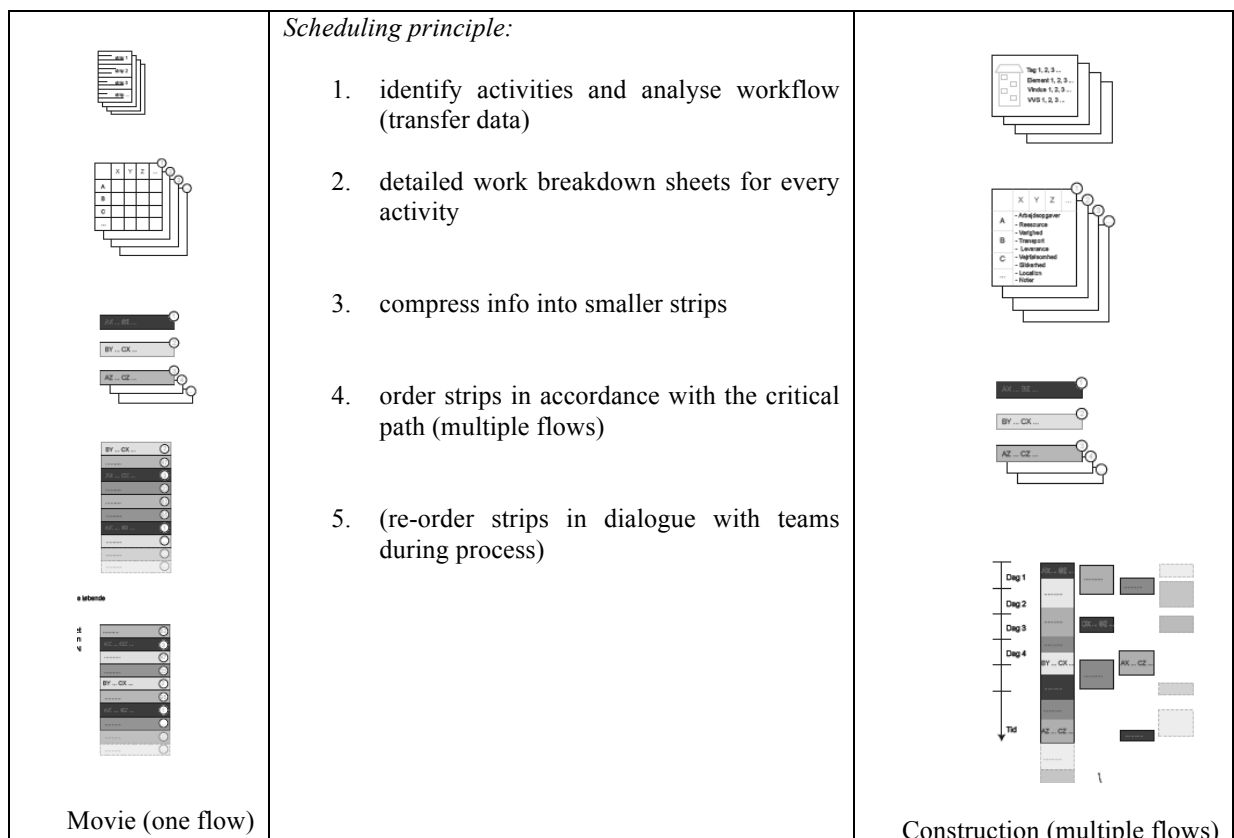
A major difference in the technology of movie making compared to construction is the synchronous production flow around every scene shot giving this ‘one-stringed’ production plan for every Unit at work called the Stripboard (example the brand Movie Magic Scheduling). When coordinating a construction site the focus is on

keeping the gangs working asynchronously around the same locations in order not to get in each other's way. This is why we see tools like LOB and LPS, which ensure that previous work has been done, before new work can begin (Kenley 2004). But this might also be the source of the largest breakdown in construction schedules, while one small delay can make the schedule fall to be just like a 'decoration on the wall' and the rest of the coordination left to informal ad-hoc deals and to the social skills of the present PM and his crew, and the project becomes subject to the effects of coincidences (Jensen 2010). But in fact the same kind of precision is required for asynchronicity as for synchronicity – any orchestral conductor will tell you this. And this is why movie making means never letting the schedule out of sight for a whole week, but rather updating progress every minute and making daily reports back to headquarter in a non-controlling way – just as a form of natural maintenance. It is a myth that time is 'wasted' on a movie set due to a large stand-by organisation (Egebjerg 2012). The stand-by time is work-time for almost all groups, preparing, checking quality, coordinating logistics etc. Similar to a construction-site where a lot of local communication and coordination takes place, only not as structured and formalized as on the movie-set.

Designing software for flexibility

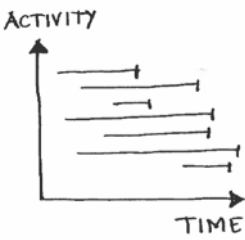
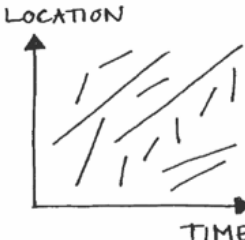
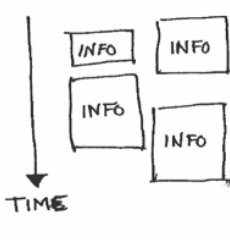
So one major challenge when designing the software was to get around designing parallel activities resulting in making the tool 100% flexible in both axis directions with parallel strings of activity but without headlines (like 'location' or 'profession' or the like).

Illustration 1: Principle of Movie Scheduling (one flow) vs. ShortCut (multiple flows)



There is only one axis-value: Time. All other information is connected with the activity in the same design-logic as an extended meeting calendar. Thus creating maximum flexibility in the design of the schedule, because activities can be moved around in time – exactly the same they are on real life construction sites every time there is a change in coordination. This design allows room for adding any kind of activity in this schedule during process: a meeting, a delivery, something to be fixed, somebody to look at something, drying time, a social event, a rain-storm passing, client inspection or anything relevant for this specific production and organisation. So one important difference from other digital micro-management tools is, that for the sake of maintaining flexibility all the information on a single activity is collected on the same sheet and not spread all over a Gantt diagram or Line of Balance view (and this holds a lot more relevant information than a network diagram).

Illustration 2: Principles of coordination, Gantt vs. LOB vs. ShortCut

Deadlines	Speed	Flexibility
 <p>A Gantt diagram with 'ACTIVITY' on the vertical axis and 'TIME' on the horizontal axis. It shows several horizontal bars of varying lengths, representing the duration of different activities.</p>	 <p>A Line of Balance diagram with 'LOCATION' on the vertical axis and 'TIME' on the horizontal axis. It shows several diagonal lines, representing the progression of activities across different locations over time.</p>	 <p>A ShortCut diagram with 'TIME' on the vertical axis. It shows four small rectangular boxes, each labeled 'INFO', arranged in a staggered pattern, representing individual information points or activities over time.</p>
Gantt	Line of Balance	ShortCut

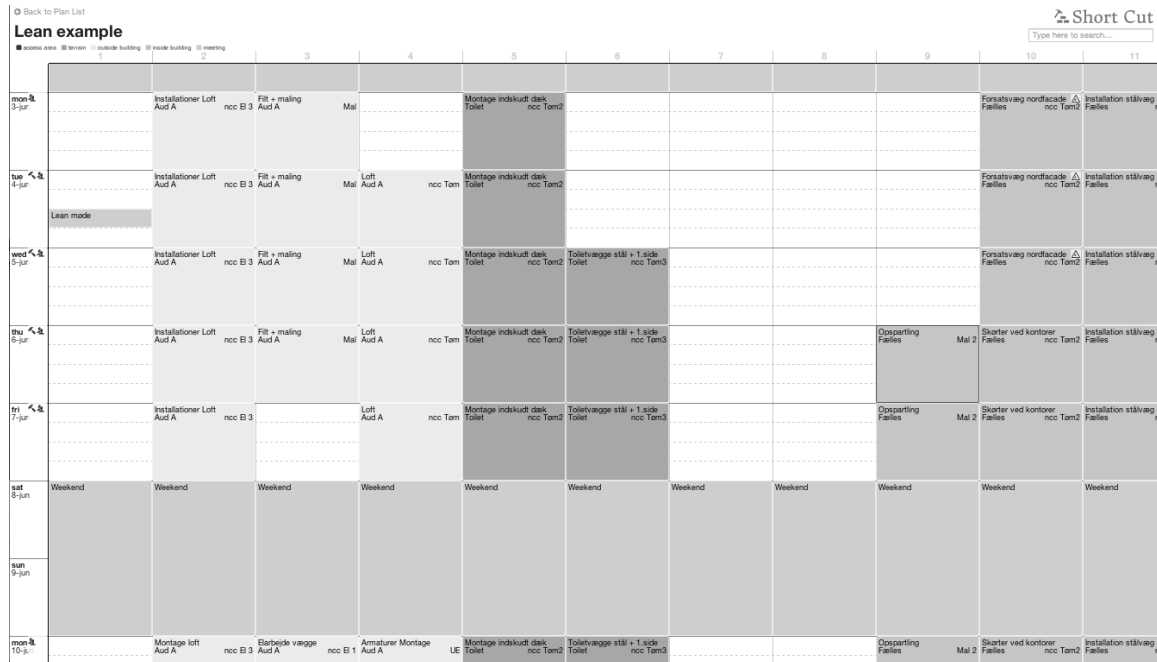
Here under is a very simplified illustration of the principle of cutting activities into smaller pieces that can more easily be coordinated (opposite to Gantt diagram's long 'black-boxes' of activities).

The level of detailing is an individual choice – It could be hours or weeks, but research recommend activities to be specified in no longer than days (by easy copy-paste). The design of this software aim to be as intuitive as possible for the user with easy drag and drop of activities, easy clicking into work break down sheet, copy-paste or delete of activities, resources and plans. It is possible to apply endless information about any kind of resources, locations, supplies, meetings, controls, links, dependencies etc. There is a search-function to search and highlight among activities for any resource named in the schedule (gang 7, location 27B, crane 2, window 187 etc.) to get a print with all activities highlighted holding this specific parameter.

Colours are used as the powerful visual tool for communication that they are: for providing an overview of working locations (and not for useless information of delayed activities, because everyone knows this already from the calendar view). There is a priority of communicating proactive warnings for weather dependencies, noise and potential clashes for locations and resources.

The theoretical logic of direct benefits from this kind of micro-coordination/-scheduling is in very short: If you have a locked schedule around the critical path, then all delays on that path will be delays for the total project. But if you have a flexible schedule that can adjust to different critical paths, then there will be an option for short cutting the initial critical path – or at least short cutting the delays on that critical path.

Illustration 3: Simplified extract from schedule after lean start up meeting



DISCUSSION: SHOW IT DON'T TELL

It is important to remember that the different industry statistics between movie and construction are all about the production phases and isolated from the overall economy of the projects. The overall economy of a movie-project including the creative development, marketing and distribution phases is more likely to be compared to the gambling industry due to unpredictable market and competition factors.

The differences on project-level should not make us believe that there is nothing to learn from the movies at production-level. Movie-sets are isolated organizations with their own working culture (Hvenegaard and Matiesen 2005) - much like an isolated entity with translated 'scripts' from the overall movie project (Egebjerg 2012, Law 1999). Inside this closed production entity the different actors can act very powerful on behalf of the fixed roles in the Hollywood management system. The camera-technology dictates the synchronicity, the 1. AD act as a timing-authority even if he is only a freelancer like everyone else, the walkie-talkie becomes an ever-present manager, and the daily time-schedule is the boss of everyone's workflow.

There are a lot of myths around movie sets that are told more as more told as 'good stories' by people inside the industry itself, but there is very little actual research on the topic. The PhD study done by Egebjerg (2012) emphasised that the daily, average movie production culture is a long way from the myths about creative chaos, working for free or under poor deals, non-productivity, changing the product-plans (script, budget and schedule) during production, management by fear or any of these other myths that might apply only to certain very artistic productions or young, independent projects. Another myth is that film workers have this personal dedication that will drive them through the processes beyond nature. The findings in the PhD by Egebjerg (2012) was, that the management system is facilitating motivation even on low-status production through a lot of instruments treats and credits, but as much by the system

itself creating non-stop dialogue around the detailed schedule strengthening the social bonds on the project.

For future integration and to gain more advantages from the software on construction sites, this research suggests minor adjustments to the site organisation also inspired from movie organisation: A process-coordinator on the site to be responsible for the daily dialogue and adjustments around the schedule plus contract supplements specifying suppliers deliverance of process-service to a central process-coordinator

Testing and user feedback

During the testing at a construction site (app. \$5m project in a three-month construction period) it became clear that the ShortCut system made sense to everybody during the first lean-meeting, since the print could provide an exact digital overview of the foremen's own, intuitive post-it coordination (pictures below) in a much clearer visual form. Suddenly it was clear for everybody to view the exact duration of processes in a calendar format, plus all the bonus information about clashes, shortage of resources, deliverances or crowded work-areas. Also they could get prints of day-schedules, week-schedules, gang-schedules, delivery-schedules, specific location-schedules etc. and it became more easy to make future adjustments to the first outline from the lean start up meeting.

Response from user groups and professionals in Denmark and US so far is very positive concerning the flexibility of the scheduling with ShortCut and the visual intuitive tool for dialogue around coordination of construction sites.

Response from a number of lean representatives from large contracting firms in San Francisco area has been even more positive to the new idea of site-management, and a couple of them proved serious commitment to the future development of the software saying they could already use it in their daily work. This higher level of interest could perhaps indicate American contractors working more structured already and with more centralised process management than their Danish colleagues.

There has been some initial scepticism around the question of how much time is required to write data into the system. The testing has shown that it is very fast just to transfer existing data to the software (1 day's work to transfer all data from a \$5m project into a ShortCut schedule). Also there have been thoughts about the challenge for the independencies of the professional groups posed by central steering of process but at the same time agreement of the need for better coordination in complex project situations. It is important to notice that there is no reason for a construction site to become entirely as lean as a movie set. So perhaps just smaller adjustments to the organisation and scheduling tools can provide a significant lift on productivity.

The indications so far from this research are that the software tool itself can stand alone to be implemented in a turn key contracts or with minor adjustments to supplier contracts in other forms of enterprise to support micro-coordination in shorter periods of a project or on certain projects where special precision is required. But perhaps in future construction markets there will be more focus on competitive process management and then be relevant to apply micro-coordination to all kind of projects. There are still many technical limitations to the prototype version, since the Realdania postdoc funding was only meant to examine the potentials of the tool and it will take more resources to implement all the ideas. There is a big challenge ahead to test a version 2.0 and make it able to integrate with existing software on the market (MS Project, BIM etc.)

CONCLUSION: KEEP IT SIMPLE

Movie-sets are in many ways similar to construction-sites with independent professional groups collaborating under changing and unforeseeable production conditions. Yet movie-sets perform far better on productivity than construction-sites do. An important advantage for the movie organisation is the digital scheduling tool that keeps the team coordinated and in trust of the reliability of the daily plans (Egebjerg 2012).

This research has shown that there is a good potential for developing a digital scheduling tool to construction sites in a different design but from similar principles as on movie sets. A prototype-version has been through an early stage test on user-groups from Danish construction industry proving its potential value for productivity through an easy, communicative overview of detailed, flexible coordination very suitable to facilitate lean-processes. The dialogue on the site is facilitated when the design of the schedules is easy to read for everyone and flexible adjusting to reality. Realising there are good reasons to trust a reliable and realistic plan is the first step in paying respect to future plans.

Realdania Research

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