21[ST] INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN, ICED17
21-25 AUGUST 2017, THE UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER, CANADA

AGILE DEVELOPMENT AND THE CONSTRAINTS OF PHYSICALITY: A NETWORK THEORY-BASED CAUSE-AND-EFFECT ANALYSIS

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Abstract

Not only software development, but also many companies developing physical products (not purely software) face high uncertainties and dynamics which raises the need for agile practices well-proven in software development. However, so-called constraints of physicality (e.g. duration to build potentially shippable increments) make it very difficult to become agile. Challenges associated with the constraints of physicality are highly interdependent and form an entangled, complex system. It is not obvious to find the root or pinpoint challenges with extraordinary high influence on others. Therefore, the investigation's goal is to identify most important challenges by separating between causes and effects. Knowing this can increase the effectiveness of research efforts in the realm of agile development. The investigation identifies 153 challenges and 160 interdependencies, and detects four backbones through the network that experts from industry rate highly influencing. Those point in particular to issues with product separation into increments, flexibility and scaling that represent very effective directions to overcome or reduce the impact of the constraints of physicality.

Keywords: Agile development, Constraints of physicality, Design methods, Design process, Visualisation

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Please cite this paper as:
Surnames, Initials: *Title of paper*. In: Proceedings of the 21[st] International Conference on Engineering Design (ICED17), Vol. 4: Design Methods and Tools, Vancouver, Canada, 21.-25.08.2017.

1 INTRODUCTION

The world becomes increasingly dynamic and uncertain. This is also true for product development (INCOSE, 2014). To master changes, developers can either try to shorten development times in order to avoid many changes to happen, or try to predict changes in order to initiate appropriate counter measures to preclude them, or invest in their readiness to react on changes. The latter can be achieved, for instance, by development agility that agile methods such as Scrum from software development promote (Stelzmann, 2011). As frequent and unforeseeable changes are inevitable in many branches of physical product development, there is a need for agility in non-software industries, too.

In contrast to traditional development approaches such as the waterfall model, agile approaches generate working increments in short and frequent iterations (couple of weeks), present them to the customer and profit from sound feedback that is incorporated into next iteration's increment. By doing so, developers experiment with solutions and learn gradually how to satisfy the customer's demand best. Due to short iterations, decentralized decision making and lightweight planning procedures, agile methods enable the developing team to respond on changes quickly and effectively.

However, so-called constraints of physicality (e.g. time to build a potentially deliverable prototype within a couple of weeks) cause many challenges while trying to adopt well-proven agile practices from software to physical product development. These challenges are highly interdependent and form a complex system without any simple pattern which makes it obscure and difficult to understand.

To solve this system of problems most effectively, research should focus on causes rather than effects. As well known in medicine, if conditions change (which is likely in dynamic environments where agility is applied), optimizations of effects will fall short of their mechanisms and underlying causes lead to the same or maybe new effects, but the problems as such remain unsolved. Therefore, the research question follows as: What is the best starting point to effectively overcome or reduce the impact of the constraints of physicality in the realm of agile development? To answer this question, the goal is to set up a directed network consisting of challenges associated with the constraints of physicality and their interdependencies, and to pinpoint backbones of highly relevant cause-and-effect chains.

The remainder firstly outlines basics of agile development and describes the constraints of physicality. Secondly, we explain the research design and relevant measurements of the network theory. Thirdly, we present the network and list challenges associated with the constraints of physicality that are, fourthly, analysed according to the research question.

2 AGILE DEVELOPMENT - STATE OF THE ART

Development "agility is the capability to react, and adopt to expected and unexpected changes within a dynamic environment constantly and quickly; and to use those changes (if possible) as an advantage." (Böhmer et al., 2015, p. 4). Agility goes back to the manifesto of agile software development which is the agreed consensus of 17 programmers on how to work more effectively and efficiently compared to traditional approaches such as the waterfall model under uncertain and dynamic conditions (Beck et al., 2001; Highsmith, 2002). The manifesto consists of four values and twelve principles. Accordingly, developing in an agile way means to value (Beck et al., 2001):

– "Individuals and interactions over processes and tools"
– "Working software over comprehensive documentation"
– "Customer collaboration over contract negotiation"
– "Responding to changes over following a plan"

Scrum, Kanban, eXtreme Programming and Feature Driven Development represent popular methods that guide developers to live these values and principles by proposing agile practices like sprint backlogs or pair programming. Although these methods are designed for software development, they are not limited to virtual products. Conforto et al. (2014) found that theoretically they are also applicable for the development of physical products such as cars or medical devices. In practice, some companies developing physical products have implemented agile practices successfully (Ovesen, 2012; Schröder and Erretkamps, 2014; Schröder and Müller, 2015; Schröder and Schrofner, 2015). However, the constraints of physicality hinder the adoption of agile methods the most as they restrict the "freedom of virtuality" (Ovesen, 2012). "In other words: As soon as the constraints of physicality would be

eliminated, there is no reason to make a context-related difference between virtual and physical products in problem- and solution-oriented research" (Schmidt and Paetzold, 2016, p. 263) in the realm of agile development.
To name a few examples: While programmers compile code once written within a couple of seconds or minutes, building physical prototypes lasts weeks or even months. Furthermore, software features are only limited by computational power, programmers' expertise and imagination. However, physical products also need to be in line with physical laws that are inescapable.
Overcoming the constraints of physicality is an unavoidable necessity to be in line with agile methods in physical product development because they rely heavily on the concept of frequent potentially shippable increments (Bahlow et al., 2013; Ovesen, 2012; Schmidt and Paetzold, 2016; Smith, 2008). This is because customers can give more sound feedback when they are able to test, feel and experience a prototype compared to documentations or virtual prototypes. In this way, prototypes, on the one hand, foster the situational knowledge that serves as early warning system for changes or misunderstandings, and enable the team to learn what satisfies the customer best (Turner, 2007). On the other hand, they generate early customer value since the customer can use them in the field already, although it might not include all features yet. Frequent prototypes also sharpen a shared product vision between both the developing team and the customer (Pichler, 2012), and push the team to deliver instead of making themselves losing in conceptual or planning details that are likely to change under uncertain and dynamic circumstances (Turner, 2007).

3 RESEARCH DESIGN

To answer the research question, the investigation starts by scanning the literature for challenges and their interdependencies. For the sake of clarity, we depict the data in a directed network. As not every cause has the same impact on an effect, we asked experts to weight the interdependencies. Lastly, we utilize the network theory tool set to perform the cause-and-effect analysis. The remainder of this section summarizes methodical information concerning the literature review, network theory and interviews.

3.1 Literature review to identify challenges

We conducted an unstructured literature review in the German or English written field of agile development to collect challenges associated with the constraints of physicality. Especially Ovesen (2012), Freudenberg and Sharp (2010), and Gregory et al. (2015) turned out to be very helpful. The former study intensively accompanies seven Danish organizations for three years that attempt to implement Scrum in their integrated product development. As a result, Ovesen (2012) lists and compares hundreds of challenges on three abstraction levels. The latter two studies placed notice boards on several conferences on software development for scientists and practitioners. They collect and cluster in total about 200 open issues in the realm of agile development that should be addressed by research. Although these issues are related to software, many of them are also relevant for the constraints of physicality (e.g. scaling issues). To gain a broader perspective on associated challenges, we also included 4 experience reports (agile physical product development only) and 7 other related academic papers. The literature review reveals 153 challenges and 160 interdependencies relevant for the constraints of physicality.

3.2 Network theory applied

In order to analyse the cause-and-effect relation, modelling the problem as a network is hardly achievable, but allows to visualize the dependency of the challenges of the constraints of physicality on each other. A network model might not be sufficient to fully understand each individual operation in detail; it could provide useful information about the complete relation in general, though. The network analysis of such a model will result in a variety of structural properties of the network and its elements. These properties are expressed in numbers, and are thus easily comparable. The values can then be connected to real properties of the actual problem. Altogether, it is to be expected that the analysis of a network model fosters a deep understanding of the dependency based on numerical values.
In general, a network constitutes of nodes that are linked by edges. Both can have certain attributes such as a weight or a colour. In this paper, nodes represent challenges and edges stand for their interdependencies. To differ between causes and effects, the network is directed (Figure 1), whereas starting points of edges indicate causes and ending points effects.

From a mathematical point of view, the meaning of nodes and edges is irrelevant (Krischke and Röpcke, 2015). With the intent to interpret the results, the meaning of all edges and nodes should be, however, consistent, since the numerical values of the networks' elements have to be comparable. The analysis gives feedback about the structure of the whole network and the position of single nodes. Network theory provides a lot of algorithms and possibilities of analysis (Chahin et al., 2016).

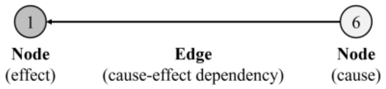

Figure 1. Elements of a network and their interpretation in a cause-and-effect analysis

As an advantage of having only one meaning of nodes and edges, it is possible to analyse a path of following nodes and edges. As it is a directed network, a circle would be a path of at least three nodes with no ending point (Figure 2 A). Such a circle means that the problem has no trigger and there is no hint for the starting node. By increasing one effect, all problems in such a chain get worse.

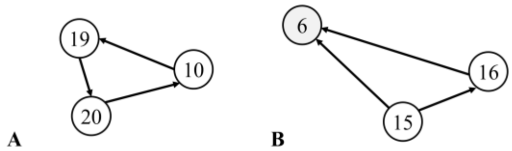

Figure 2. A: Three nodes forming a circle; B: Two nodes 6 and 16 influenced by node 15

If one edge has an inverse direction, it is a bypass (Figure 2 B) as two or more sources of an effect point directly or passing further nodes to that effect. Analysing that situation explains easily that node 15 should be solved first, because of the minor effort needed to reduce the effect on node 6 and 16. In contrast, solving node 6 or 16 would affect only one or no other node.

3.3 Interviews to weight the causes' impact on an effect

Since an effect can be provoked by several causes to a different extent, it is necessary to weight each edge with the degree of impact of the specific cause on the effect. For that, each node's incoming edges were rated on a 10-point Likert scale whereas 1 refers to "hardly any impact" and 10 "very high impact". To assure that incoming edges are rated relatively to each other (and not relatively to the entire network), each set of incoming edges of a specific node needs to have at least one edge weighted by 10.

As we did not find experts from industry willing to rate 160 edges, we focus on the inner 1/3 of the network only (breadth-first search strategy). This subnet consists of 51 nodes and 63 edges (see Section 4 for more details).

We conducted six face-to-face interviews with practitioners (Table 1). Four of the interviewees work for the same consulting company, three of them (b - d) within the same development team. On the one hand, they train and consult their clients in issues related to agile development of physical products, but, on the other hand, they also internally develop products for their clients in an agile manner as an engineering service. Two more experts were interviewed from other companies to analyse differences in company-specific influencing factors. Table 1 provides further details.

During the interviews we, firstly, presented the entire network (153 nodes, 160 edges) derived from the literature review. Then, we asked for the interviewee's perceived degrees of impact, successively, for each node's incoming edges within the subnet. If they face challenges other than those presented, they were free to add them to the network. If a challenge is not relevant at all, they should rate the corresponding edge with 0.

Table 1. Practitioners interviewed

ID	Company	Branch	Role	Products	Experience with Agility in Phys. Prod. Dev.
a	A	Engineering Consultancy	Consultant	Mechatronical devices	4 - 5 years
b	A		Systems Engineer		2 - 3 years
c	A		Software Engineer		2 - 3 years
d	A		Agile Coach, Project Manager		4 years
e	B	Electrical Tools	Head of R&D	Mechatronical devices	>10 years
f	C	Medical Devices	Systems Engineer	Mechatronical devices	2 - 3 years

4 FINDINGS - NETWORK OF CAUSES AND EFFECTS

On the one hand, constraints of physicality are caused by difficulties in (a) separating development tasks, (b) estimating these tasks in terms of time and resources, (c) defining viable increments for each iteration, and (d) being flexible enough (Ovesen, 2012). Furthermore, constraints of physicality arise from (e) methodical shortcomings because no agile method for physical product development exists so far (Gregory et al., 2015), and (f) scaling issues because physical product development usually involves a higher number and variety of disciplines than pure software products (Freudenberg and Sharp, 2010; Gregory et al., 2015). On the other hand, the constraints of physicality cause difficulties in (a) presenting working product increments that are potentially shippable (Ovesen, 2012), (b) responding to changes quickly since iterations are too long (Ovesen, 2012), and (c) they lead to the fact that agile practices are rarely used in the development of physical products (Link, 2014).

Table 2. Challenges within the subnet: Node descriptions of Figure 3 and Figure 4

ID	Node description	Source
1	Hard to overcome the constraints of physicality	Ovesen, 2012
2	Hard to separate deliverables for each iteration	Ovesen, 2012
3	Hard to "breaking down product development tasks" (Ovesen 2012, p. 125, 163)	Ovesen, 2012
4	Hard to estimate time and resources on development activities	Ovesen, 2012
5	Hard to scale	Gregory et al., 2015; Freudenberg and Sharp, 2010
6	Hard to be flexible enough	Ovesen, 2012
7	Methodical shortcomings exist	Gregory et al., 2015
8	Hard to sell a product that isn't there	Ovesen, 2012
9	Hard for customers to evaluate iteration delivery	Bahlow et al., 2013; Ovesen, 2012
10	Hard to develop potentially shippable increments each iteration	Ovesen, 2012
11	Change in attitude rather than a technical change needed	Ovesen and Dowlen, 2012; Ovesen, 2012
12	Hard to implement appropriate governance mechanisms	Gregory et al., 2015
13	Hard to apply agility in large endeavors	Gregory et al., 2015; Freudenberg and Sharp, 2010
14	process of how to scale insufficiently known	Freudenberg and Sharp, 2010
15	Hard to manage "supplier delivery times and other external dependencies" (Ovesen 2012, p. 103, 163)	Ovesen, 2012
16	Hard to keep all options open	Ovesen, 2012
17	Difficult to change horses in the middle of the stream	Ovesen, 2012
18	Hard to conceptualize product increments each iteration	Ovesen, 2012
19	Hard to manufacture independent product increments each iteration	Ovesen, 2012
20	Hard to test independent product increments each iteration	Smith, 2008
21	Hard to change from old habits	Ovesen, 2012
22	Agility = mind set <> methodology	Gregory et al., 2015
23	Hard to scale due to complexity	Gregory et al., 2015
24	Hard to interpret agility on program level	Gregory et al., 2015
25	Hard to cooperate	Ovesen and Dowlen, 2012; Bahlow et al., 2013
26	High number of involved disciplines and departments	Bahlow et al., 2013
27	Hard for mechanics when nothing is fixed	Ovesen, 2012
28	Right balance between flexibility and design setting unkonwn	Freudenberg and Sharp, 2010
29	Especially hard for mechanics to deal with changes occurred	Ovesen, 2012
30	Changes occured often come along with large consequences	Ovesen, 2012
31	Too long iteration cycles to really respond to the unforeseen	Ovesen, 2012
32	Team does not delivery value to customer	Conboy et al., 2011
33	Agile methods are used in sectors where it has not been intented (e.g. public sector)	Gregory et al., 2015
34	Agile methods are used in sectors where application experiences are rare	Gregory et al., 2015
35	Hard to prioritize tasks	Ovesen, 2012
36	Hard to "breaking tasks into smaller items in the sprint backlogs" (Ovesen 2012, p. 71, 163)	Ovesen, 2012
37	Scrum requires to build "individual functions across those platforms" rather than "products in platforms" (Ovesen 2012, p. 71)	Ovesen, 2012
38	Breaking down a traditional project specification into work packages that can be fitted into the duration of a single iteration	Ovesen, 2012

Consequently, the central node of the network is "Hard to overcome the constraints of physicality". This node has six causes and three effects (see previous paragraph). The remaining nodes are directly or indirectly linked to these six causes. Figure 3 visualizes the structure of the network and Table 2 provides the problem descriptions. The subnet addressed in the interviews contains all nodes and edges that are at least one hop (two edges and three nodes) and at maximum two hops (three edges and four nodes) away from the central node. In this way, the subnet consists of 51 nodes and 63 edges that represent roughly 1/3 of the entire network.

As combinations of following edges with high impact ratings form an important cause-and-effect chain, we scanned the data from the interviews, accordingly. Figure 3 and Figure 4 depict all chains that are connected to the central node. Each colour represents one interviewee.

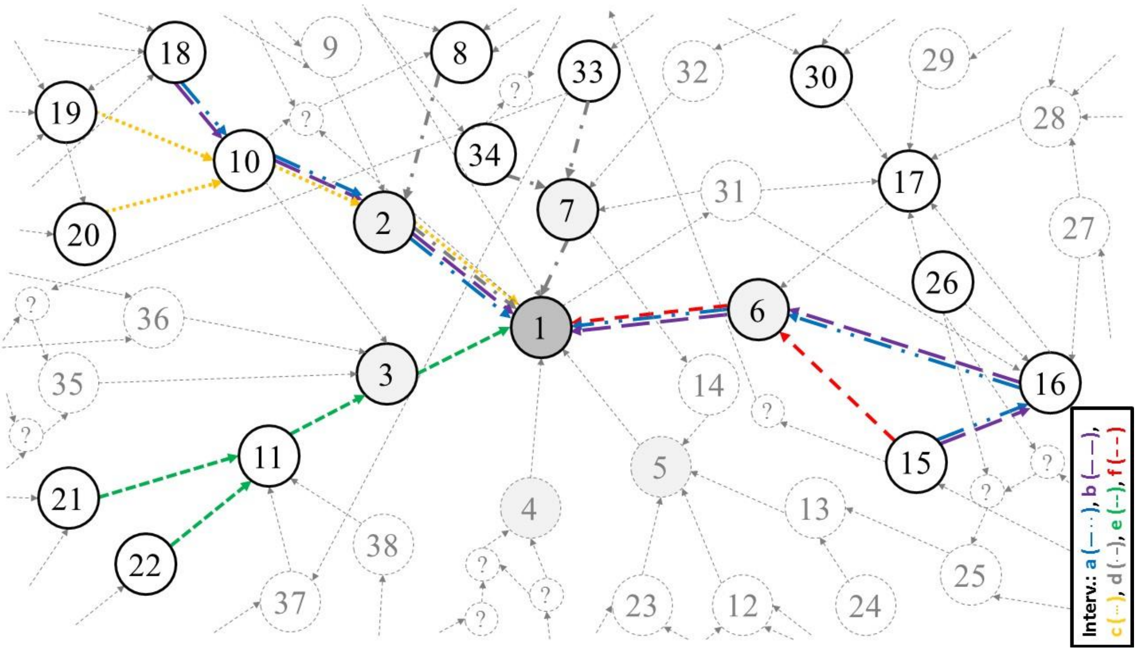

Figure 3. Abstract of subnet with interviewees' ratings =10

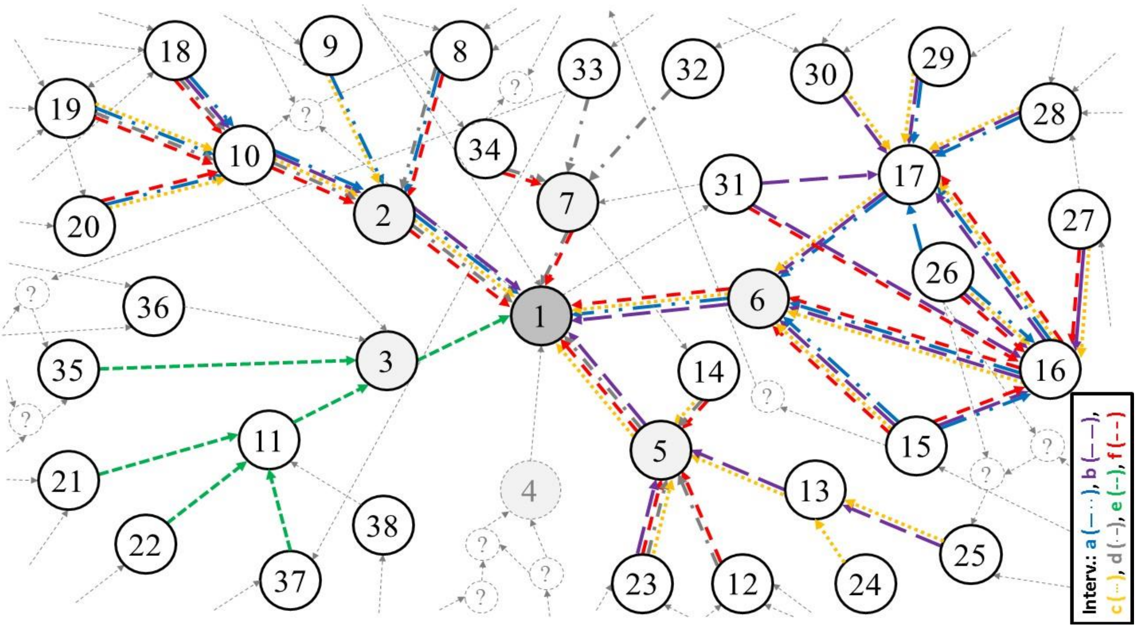

Figure 4. Abstract of subnet with interviewees' ratings ≥7

5 CAUSE-AND-EFFECT ANALYSIS

As visualized in Figure 3 and Figure 4, the interviewees' ratings reveal clear directional tendencies due to overlapping paths. Following subsections describe and analyse them on two levels of strictness: (a) impact rating equals 10 and (b) impact rating is greater than or equal to 7. Of course, the smaller the threshold, the more cause-and-effect chains consisting of at least two edges become visible, but the less they are important. However, thresholds used here (=10 and ≥7) refer to a very high impact. The analysis subdivides into an in-depth perspective on company A (since four interviewees work for company A), a comparison between companies, and a comparison between roles of the interviewees.

5.1 In-depth analysis within company A

Limiting the data of Figure 3 and Figure 4 on interviewee a, b, c and d shows that these rating have a very high degree of internal consistency. In other words, there are only little differences between the ratings. When four persons follow almost the same route through a relatively closed-meshed network, it means that the ratings are highly reliable. This, in turn, refers to main routes through the network rated with a high impact by most interviewees (more than 50%). Three of those cause-and-effect chains stand out:

- **Separation issues backbone**: constraints of physicality - =10: 4/4; ≥7: 4/4 - hard to separate deliverables for each iteration - =10: 3/4; ≥7: 4/4 - hard to develop potentially shippable increments each iteration - =10: 2/4; ≥7: 3/4 - hard to conceptualize
- **Flexibility issues backbone**: constraints of physicality - =10: 2/4; ≥7: 3/4 - hard to be flexible enough - =10: 2/4; ≥7: 3/4 - hard to keep all options open - =10: 2/4; ≥7: 2/4 - hard to manage "supplier delivery times and other external dependencies" (Ovesen, 2012)
- **Scaling issues backbone**: constraints of physicality - =10: 0/4; ≥7: 3/4 - hard to scale - =10: 0/4; ≥7: 3/4 - hard to scale due to complexity

While the former has a very high density of 4/4 interviewees on the first edge, 3/4 on the second edge and 2/4 on the third edge on the highest strictness level, the density remains the highest on that route on the lower strictness level. The flexibility issue route has a medium density of 2/4 that stays constant. 50% of the interviewees follow the exact same path on strictness level =10. Although scaling issues are not visible on the strictness level =10, three out of four interviewees find it relevant on the lower level.
As the strictness threshold lowers, the more visible becomes the spreading effect. This is natural as mentioned above since less important paths come into play. However, it is remarkable that even with a threshold ≥7 distinct directions stand out, although the interviews were conducted independently.
In summary, separation issues are found to be the most influencing route (priority 1), followed by flexibility issues (priority 2) and scaling issues (priority 3). Methodical shortcomings are less relevant as they are only rated by one interviewee, even on level ≥7. Task break down issues and estimation issues, in turn, are not relevant for company A according to the data. Knowing that reveals that out of 25 possible directions on the second layer (number of incoming edges of nodes being one edges away from the central node) only three directions are highly influencing which refers to a reduction of 88%. Company A should further investigate these three backbones to find main causes. Solving those will have the highest impact on overcoming the constraints of physicality for them and makes the effort effective.

5.2 Comparison between companies

Although the ratings of company A have high internal consistency, the backbones of company A are not identical to company B and C. Just as company A, interviewee f of company C assigns the highest impact (10) on flexibility issues, but it is not the exact same route as company A takes. Company C chooses a shortcut. However, both routes point to the same cause being 'hard to manage "supplier delivery times and other external dependencies" (Ovesen, 2012)'. On the lower strictness level (≥7), the ratings of interviewee f are widely spread which makes it more difficult to identify less important, but distinct backbones. As two paths via separation issues and task break down issues lead back to the challenge 'hard to develop potentially shippable increments each iteration', ship ability can be seen as another backbone (priority 2) after flexibility issues (priority 1). Methodical shortcomings and scaling

issues are two more backbones of priority 2 for company C. Estimation issues are not relevant for interviewee f.
Compared to company C, the ratings from company B are extremely narrow. Task break down issues are very distinct on both strictness levels. Thus, there is only one backbone for company C: constraints of physicality - hard to break down product development tasks - "change in attitude rather than a technical change" (Ovesen and Dowlen, 2012, p. 13) needed. In case of company B, it is possible to reduce possible directions from 25 to 1 on the second layer (96%), whereas company C reaches 64%.
In summary, company A and C are relatively similar in terms of their main routes, although company C finds a broader variety of influences decisive. Company B, though, has only one clear backbone standing out that is very narrow compared to company C. Consequently, the main routes seem to be company-specific and context-dependent.

5.3 Comparison between interviewees' roles

As stated in Table 1, interviewee e is a top manager (head of R&D). He highlights the main route 'constraints of physicality - task break down - change in attitude' that are rather administrative challenges. Especially the last chain element (change in attitude) refers to company culture which is mainly determined by top managers (Schein, 2010).
Interviewee d as an agile coach consults internal teams in terms of methodical correctness. Consequently, he finds methodical shortcomings decisive, but also the separation of increments on each sprint. According to his ratings, the latter is caused especially by difficulties to sell product increments that are not physically available.
Members of agile teams (interviewee b, c and f) prioritize flexibility issues caused mainly by supplier management, separation and ship ability issues, and scaling issues due to complexity. These are rather operative hindrances. However, ratings of these interviewees overlap well only on the strictness level ≥8. This could be because they belong to two different companies (context-dependency).
Interviewee b and f are systems engineers. Their main routes are mostly overlapping, especially when it comes to flexibility issues and management of external dependencies. However, on strictness level ≥8 also scaling issues due to complexity and separation issues due to ship ability are distinct routes. However, on strictness level ≥9 the overlap is very good, on strictness level ≥7 there are many differences, which is mainly due to interviewee f's wide spread ratings.
In summary, interviewed persons reference their ratings according to their job roles (anchoring effect) since, for instance, an engineering on team level prioritize rather operative challenges and top manager rather administrative ones. This is consistent with the data from the interviews. But on the basis of our data it is difficult to differentiate between context-dependency and role-dependency. Both effects might play a role.

6 DISCUSSION

Remarkably, ratings of all interviewees from company A overlap to a very high degree. This internal consistency means (a) a high reliability of the data, and (b) as the ratings of company B and C are quite different, ratings might be context-dependent. However, the data does not allow an obvious differentiation between role- and context-dependency, both dependencies might play a role, though.
As a result, following overall priorities can be assigned to found backbones.

- **Priority 1**: 'Constraints of physicality - separation issues - ship ability issues' is a highly influencing backbone for most of the participants (=10: 2-3/6; ≥7: 5/6).
- **Priority 2**: 'Constraints of physicality - flexibility issues - (keeping options open) - management of supplier and external dependencies' is a highly influencing backbone for most of the participants (=10: 3/6; ≥7: 4/6).
- **Priority 3**: 'Constraints of physicality - scaling issues' is an influencing backbone for most of the participants (=10: 0/6; ≥7: 4/6).
- **Priority 4**: 'Constraints of physicality - task break down issues' is a highly influencing backbone for some participants (=10: 1/6; ≥7: 3/6).

Furthermore, it is possible to state that:

- Methodical shortcomings are of minor importance as they are rated with high impacts very rarely.
- Estimation issues seem to be relatively irrelevant for the constraints of physicality. No interviewee finds it decisive.

To answer the research question, problem solving should focus on above-mentioned priorities. In this way, trouble-solving efforts become effective as - depending on the context - 64 - 96% of all possible directions are excluded on the second layer. Above prioritized backbones represent good starting points for both in-depth network analysis and trouble-solving. The former can be achieved when irrelevant routes are hidden and the subnet is enlarged in the direction of the main routes (breadth-first search). The latter should follow back these backbones to detect the main causes. Solving these causes will have the highest impact since they then positively affect downstream challenges and, in the end, extraordinarily contribute towards overcoming the constraints of physicality.

7 CONCLUSION, LIMITATION AND FUTURE WORK

The investigation sets up a directed network consisting of 153 challenges and 160 interdependencies. By doing so, we differ between causes and effects in order to follow back highly influencing cause-and-effect chains to main causes. Treating underpinning causes instead of their symptoms (effects) rise the effectiveness of solution-oriented research. As a result, we identify and prioritize four of those backbones that stand out clearly and reduce the number of possible directions on the second layer (two edges away from the central node) by 64 - 96%. The investigation contributes by recommending effective ways to overcome or reduce the impact of the constraints of physicality in the realm of agile development.

Several limitations restrict the value of above findings. Firstly, the list of challenges identified might be, on the one hand, not exhaustive and, on the other hand, constantly changing by progress in research and practice. That is because the field of agility is not mature yet (Dingsøyr et al., 2012). However, maturity might vary a lot among the industries whereas software development is the most mature one due to its precursor character. Nevertheless, enlarging the underpinning data set, especially by including more experience reports leads to a more accurate network and, in the end, to more precise analysis results of course.

Secondly, we added many (obvious) interdependencies. For sure, a more comprehensive literature review could reveal more linkages being justified in case studies for instance. Nonetheless, further research need to be done to find out also (a) non-obvious relationships and (b) hidden, maybe skipped nodes of the cause-and-effect chains being unknown so far.

Thirdly, future work should further stress the differences between context- and role-dependency. This could be achieved, for instance, by comparing identical roles of different companies. Lastly, beyond the rather technical constraints of physicality also people-related factors need to be addressed in order to increase agility (Conboy et al., 2011; Ovesen, 2012).

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