01 From Chain of Causation to Net of Causation: It only took a century

From "Chain of Causation" …

The concept of the "chain of causation" is one of the cornerstones of the law and, as such, it is fully applicable in delay and disruption disputes: establishing a causal link between any losses suffered and the events or actions that may have led to them is a key requirement to sustain any construction claim.

Take, for example, a simple claim for a delay to a project:

a) If the Employer delayed the completion of a specific construction activity; and

b) If (to keep matters simple) this was the only impact on the project (by either party); and

c) If this activity was (at the time when it occurred) on the project's critical path;

d) Then, the project would have been delayed by the same amount as the delay to the activity.

In this example, the chain of causation is extremely straightforward – see Figure 1 below:

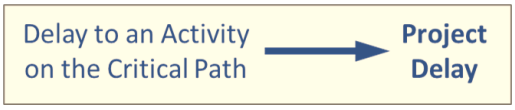

Figure 1: A simple causal chain.

But of course, the reality on construction projects is never that simple – so much so, in fact, that in delay and disruption disputes the "chain of causation" is actually much more than a chain!

… to "Net of Causation"

Construction delay and disruption disputes routinely deal with numerous causes, many of them with knock-on, overlapping and/or interrelated consequences.

To illustrate this point, let us use a second, somewhat more realistic example, this time applying to a disruption dispute: A Contractor claims that a design change by the Employer forced him to undertake several design revisions, and that these led to rework and to out-of-sequence work that caused productivity losses. The Employer, on the other hand, claims that both the rework and the productivity losses were caused by the Contractors' own inefficiencies.

These causal chains are depicted in Figure 2. It is a fact that the design change did happen, and that it caused several design revisions, and it is a known fact that late design revisions often cause out-of-sequence work, and that this affects work productivity. It is also axiomatically true that nobody is perfect, and, considering the overall industry performance, it is probable that the Contractor may indeed have been involved in some inefficiencies of his own. Thus, on the face of it, both causal chains appear to reflect reality, and thus be legitimate, even probable.

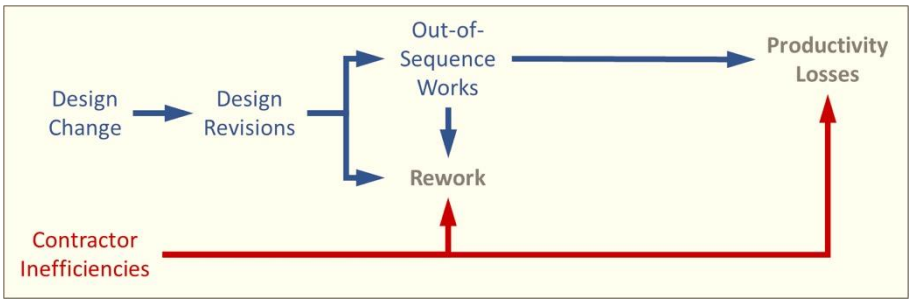

Figure 2: Two competing causal chains.

But actually, to properly look into this matter, we should still consider a few additional issues that also form part of the reality of construction projects, and which are relevant to the case (see Figure 3, below):

a) Both rework and productivity losses routinely lead to project delays: rework involves the forced repetition of work already done previously, and productivity losses - by definition - imply a slowing down in the pace of the work;

b) In turn, project delays normally lead to acceleration measures that add manpower to the project… which drives out-of-sequence work… which, in turn, leads to additional rework and productivity losses… and so on and so forth.

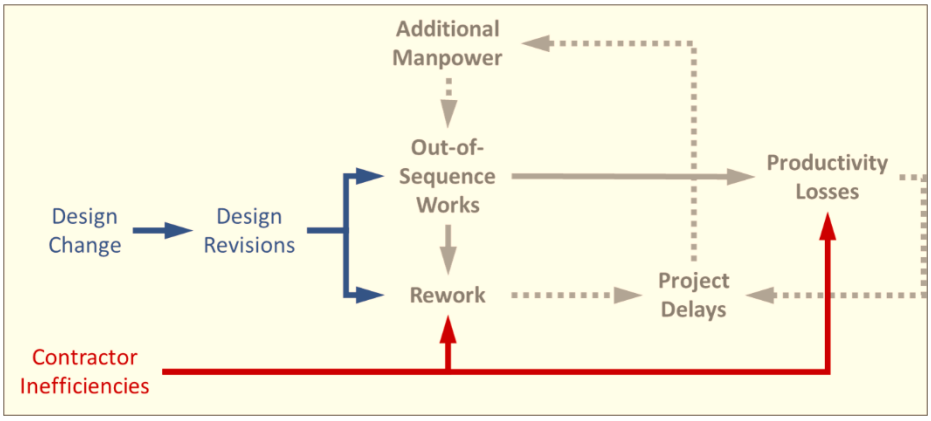

Figure 3: Additional causal links end up forming causal loops.

When addressing causation in delay and construction claims, we normally need to deal with a complex set of multiple, criss-crossing chains of events – so much so, in fact, that we should ask ourselves whether the concept of "chain of causation" itself is still adequate in this context. We believe that Lord Shaw of Dumferline hit the nail on the head with the following general comment that he included in his judgment on *Leyland Shipping v. Norwich Union Fire Insurance Society* (emphasis added) [1]:

> *The chain of causation is a handy expression, but the figure is inadequate.* ***Causation is not a chain but a net****. At each point influences, forces, events precedent and simultaneous, meet, and the radiation from each point extends infinitely. [Emphasis added]*

[1] Leyland Shipping v Norwich Union Fire Insurance Society [1918] AC 350 HL, pp 368-369.

But for the appropriate tools…

The concept of the "net of causation" allows us to look more accurately at "causation" in construction disputes – but it still leads to more questions than answers, especially when apportioning damages.

The issue is not legal or contractual, but technical: how do you apportion damages in a network of causes? The conventional method to establish factual causation is the "But For" test – i.e., asking oneself how the construction project would have performed (what damages would have been avoided) 'but for' this or that breach of the contract? ("… had this or that breach not happened?")

The problem becomes even more complex when one considers that several paths in our net of causation ended up forming closed, interlocking loops (see again Figure 3): How can one apportion damages based on a never-ending causality, with causes and effects going around in loops, over and over? Until recently, there just did not exist a scientific approach able to deal with all the complexities associated with a "net of causation" – and, for this reason, the concept remained in relative obscurity, and the "chain of causation" continued to reign supreme:

- In face of the limitations shown by the different assessment methods, legal scholars have attempted to provide some additional guidance by suggesting, for example, the existence of causes with different "potencies" or "efficacies", etc. However, the practical implementation of these advisory concepts could never rise above the level of common sense, rules of thumb or informed expert judgement.
- "Causal Matrices" were created to graphically represent nets of causation, and thus shed some light on their complexities – but the graphics were not accompanied by any associated algorithms or methods for calculating or assessing damages.

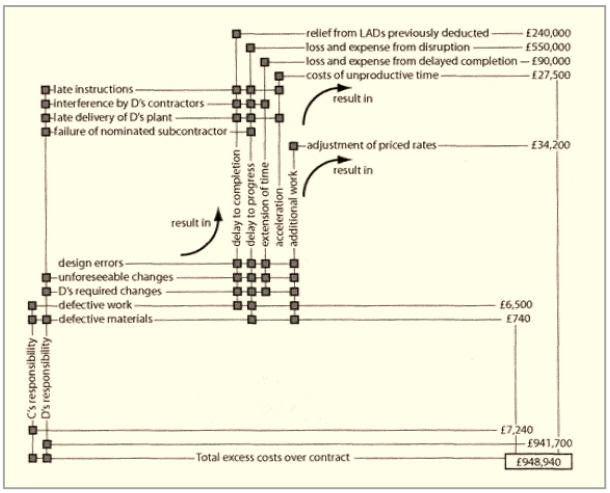

Figure 4: An example of a Causal Matrix.[2]

- Most delay assessment methods pruned the causation network and dealt only with impacts on linear, non-interactive, non-iterative strings of activities (the "Critical Path", see again Figure 1) – ignoring all other causal links, especially those that would lead to highly non-linear, recursive, and branching causal loops (like dealing with rework, etc.)

[2] Graphic excerpted from Pickavance, K., "Delay and Disruption in Construction Contracts", 4th Edition, 2010, p. 498.

- Disruption methods were forced to "stay above the fray": Confronted with the multiplicity of interlocking causes and effects leading to disruption, and lacking any adequate scientific framework to apportion damages in such a situation, they:

    a) Did not apportion damages at all, producing "Global Claims" to recover all costs incurred.

    b) Proposed allocations based on "industry standard" loss factors (or similar project comparison studies), thus ignoring the actual reality of the project being assessed; or,

    c) Restricted themselves to small areas of the project, where actions and consequences could be tracked individually (for example, using the "Measured Mile" approach.)

A technological breakthrough: System Dynamics

In 1956, Jay W. Forrester, a professor at MIT's Sloan School of Management, started to develop a new "theory of systems", to help explain the behaviour of complex "social" systems – be it economies, markets, industries, cities… and yes, also projects.[3]

This new "theory of systems" was eventually named "System Dynamics", and it created structured ways to describe the nets of causation present in social systems; but, much more importantly, it also developed the techniques needed to express the performance resulting from these causal nets in mathematical form, thus finally enabling a much more profound (and accurate) understanding of the messy and non-linear behaviour of complex systems.

In 1976, System Dynamics was first used to develop a causal framework for delay and disruption, to serve as the basis for an assessment of a US defence project[4]. This framework proved to be so powerful and so versatile that, following the success of its initial application, it has since been used on hundreds of projects worldwide, and in all kinds of industries – both proactively (to help anticipate and minimise disruption and delay), and retrospectively (in disputes.)[5]

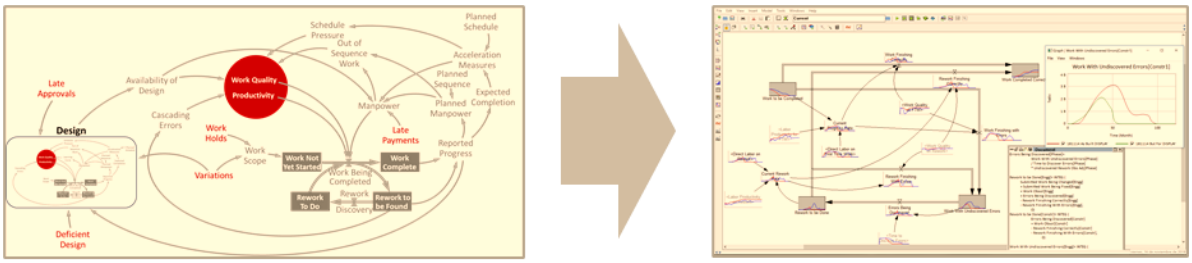

Figure 3: A System Dynamics simulation model, and the causal framework underpinning it.

[3] Forrester, Jay W., "The Beginning of System Dynamics", banquet talk at the international meeting of the System Dynamics Society, 1989.

[4] Cooper, Kenneth G., "Naval ship production: A claim settled and a framework built", INTERFACES Vol. 10, No. 6 December 1980, The Institute for Management Sciences.

[5] This causal framework will be described in more detail in later issues in this series, please check our website: www.constructiondynamics.global/on-disruption-and-delay.

It only took a century

System Dynamics was the technological breakthrough that finally allowed analysts to deal with complete "nets of causation" in a robust, scientific, and defensible manner. And yet, the legal world remained mostly unaware of it for decades.

While System Dynamics was first used on a project in a legal environment (a claim), and even though it has since been used in more than fifty additional disputes worldwide, System Dynamics experts have focused their efforts mostly in establishing the reputation of the methodology in professional organisations – eventually gaining recognition from the Engineering Construction Risk Institute (ECRI), the Project Management Institute (PMI) and the American Society of Civil Engineers (ASCE), among others.

It was not until 2017 when, as a result of a mounting number of uses and successes of System Dynamics in claims, that the next major chapter in this story was written: that year, the Society of Construction Law published the second edition of its "Delay and Disruption Protocol", and it included System Dynamics as a recognised method to assess disruption on complex construction projects.

It took a while, but ninety-nine years after Lord Shaw proposed the idea, the concept of the "net of causation" and its practical applications to delay and disruption claims have finally started their push into the mainstream of construction law.

Construction Dynamics Solutions

For more information, please contact us at:
info@constructiondynamics.global
or visit our website:
www.constructiondynamics.global/on-disruption-and-delay

