INVISIBLE TRADE-OFFS AND VISIBLE CONSEQUENCES

In a world of ever-increasing information, overload can be a problem. Since there is a constant pressure to be efficient, we cannot always be as thorough as we want or need to be. **Erik Hollnagel** outlines a number of strategies that we use to try to manage information, before it manages us.

KEY POINTS

- **We make countless small trade-offs throughout every working day. Because we make them all the time, and because they contribute to work going well, we soon stop paying any attention to them.**
- **Information input overload clearly represents a goal conflict between thoroughness and efficiency.**
- **We use a number of different strategies to allow the required or intended actions to be carried out as they should be, or at least before it is too late. These include: reduced precision, filtering, cutting categories, queuing, omission, decentralisation, and escape.**
- **These strategies usually serve us well, but may under certain conditions interact to produce unexpected and unwanted outcomes.**
- **While there are no easy solutions to this dilemma, we should at least try to be aware of it, and to pay more attention to the 'non-events' that are the foundation for work well done.**

Goal conflicts are a fact of life for all of us from the moment we wake up to the time we go to bed. In fact, even deciding whether to get up in the morning when the alarm sounds or to stay in a comfortable bed for another 10 minutes can sometimes be a goal conflict. The consequences of making the wrong trade-off when the day begins may at first seem trifling compared to the consequences of making a wrong trade-off during work, not least if you are pilot or an air traffic controller. In reality, the differences are not as large as they may seem at first glance, since getting out of bed too late simply is one trade-off among countless others that in combination eventually may lead to outcomes that were unimaginable – or at least not imagined – at the start.

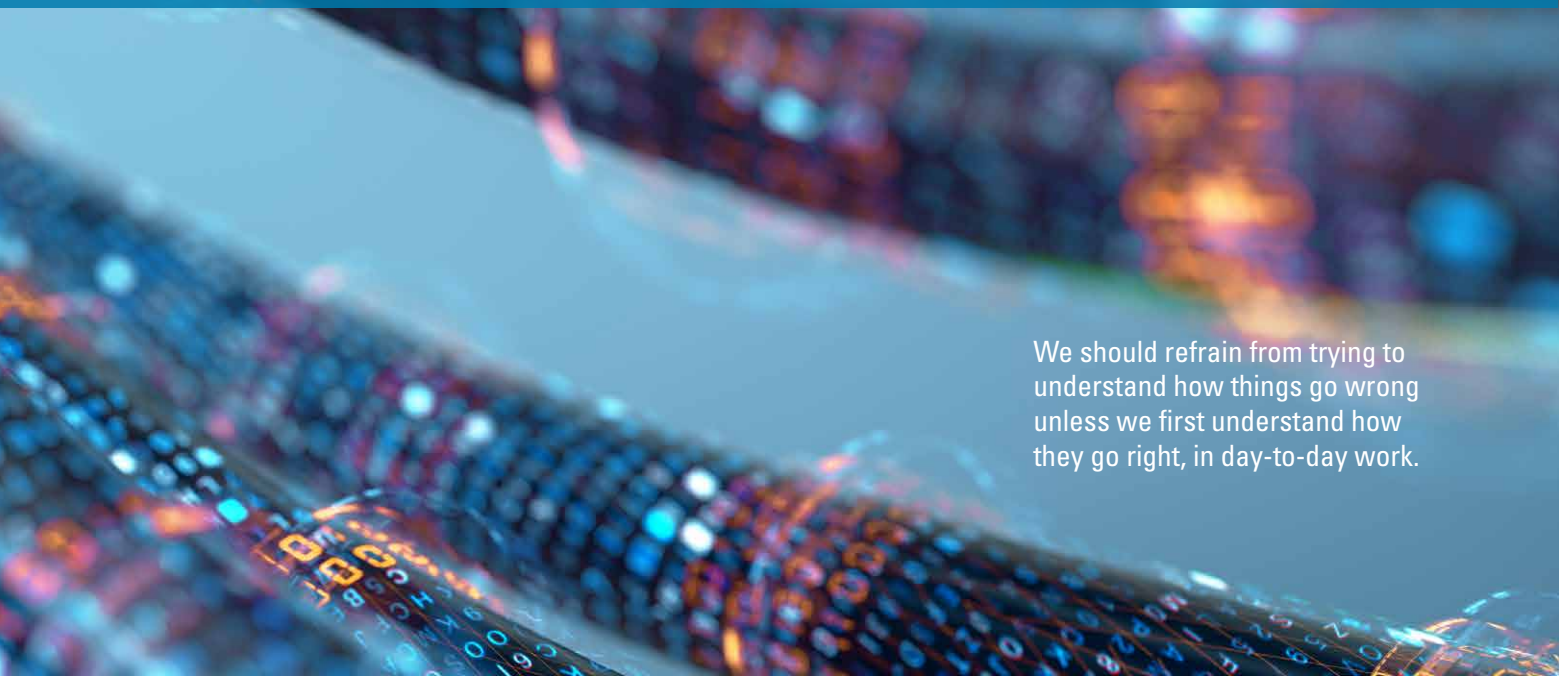
We always pay attention to the large goal conflicts – for instance the dilemmas between safety and productivity – since they, like accidents, are difficult to miss. But as Karl Weick astutely pointed out in his discussion of reliability (and by the same token safety) as "a dynamic non-event" (Weick, 1987), the non-events are not only easy to miss but in everyday life practically invisible. Yet they are invisible because we habituate or get used to them rather than because they are difficult to 'see'.

In the same way, we make countless small and smaller trade-offs throughout every working day. But because we make them all the time, and because they contribute to work going well, we soon stop paying any attention to them. This is understandable, if not quite forgivable, within the traditional approach to safety (Safety-I), which relies on linear cause-effect reasoning to backtrack from accidents to their causes. It is consistent with this way of thinking that there is some kind of proportionality between the value and magnitude of outcomes and the value and magnitude of causes. But it is widely acknowledged today that much of what happens around us can best be described and understood as if systems and organisations are non-linear and the outcomes are therefore 'emergent'. This has been expressed as the 'equivalence principle', which states that acceptable and unacceptable outcomes happen in roughly the same way.

In consequence of that, we should refrain from trying to understand how things go wrong unless we first understand how they go right, in day-to-day work. It therefore becomes important to understand the ubiquitous everyday trade-offs and the corresponding seemingly innocent goal conflicts, since they are the reasons why work usually goes well. Since getting up in the morning only takes place once a day, a better illustration is provided by a goal conflict that most of us are faced with many times a day, namely how to deal with an overload of information.

Information input overload

A crucial skill in our world today is the ability to manage the ever-growing streams of information that are forced upon us, and to do it in time, i.e., fast enough to allow actions to be taken before it is too late, or even just to notice the information before it disappears. This ability is put to the test in conditions where there is more information than can be handled, known as information input overload. Examples range from the alarm avalanche in a cockpit or a control room when a serious disturbance occurs, to the feeling of frustration that comes over us when we are confronted with the all too many (unanswered) emails that clutter our inboxes. Information overload is, of course, a relative rather than an absolute condition. It is not the amount of information as such that defines it, but rather whether there is more information that can be handled at the specific moment in time. This can occur if the rate of input increases, if the processing capacity decreases, or if both happen at the same time.



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A crucial skill in our world today is the ability to manage the ever-growing streams of information that are forced upon us, and to do it in time.

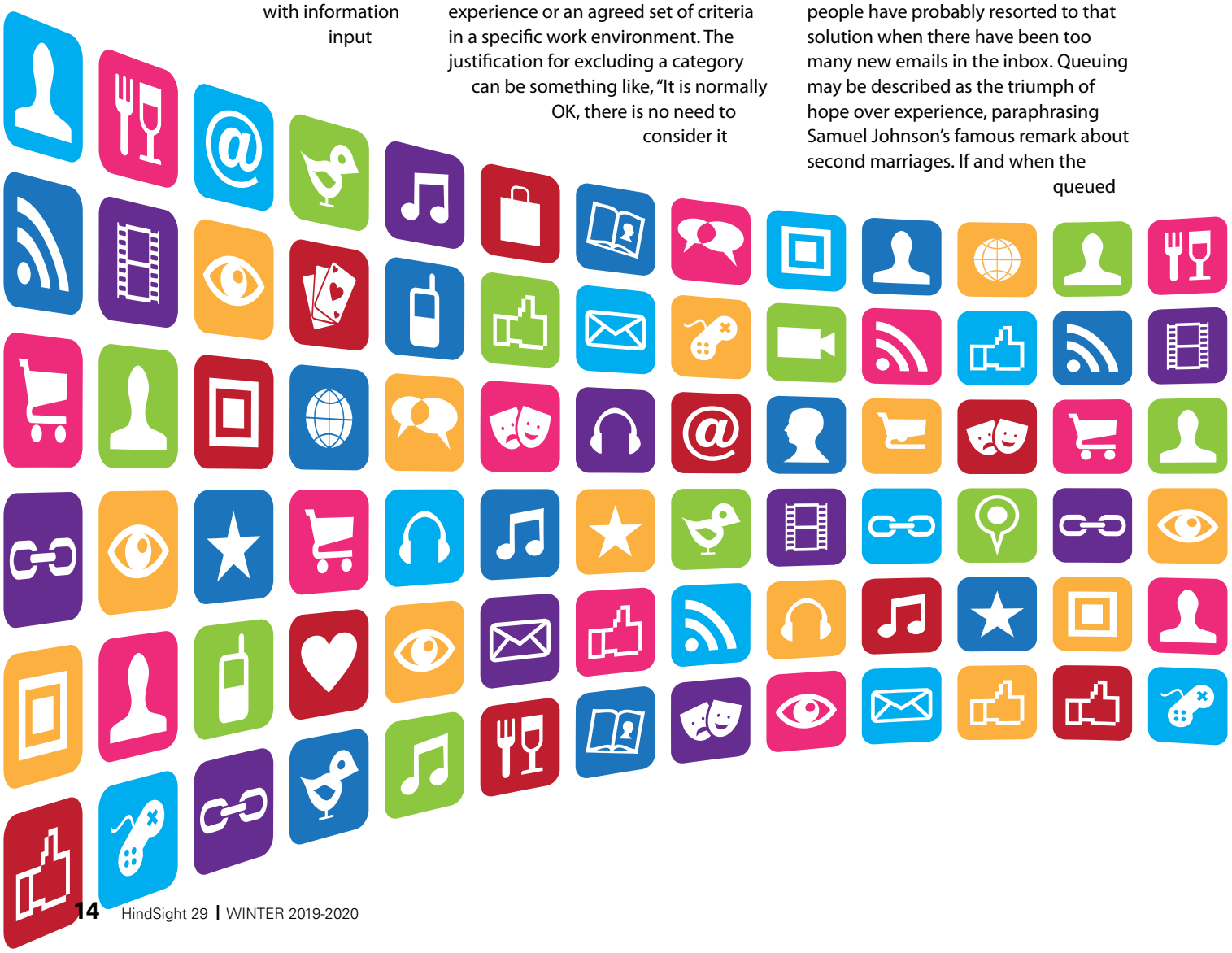
Information input overload clearly represents a goal conflict. On the one hand, there is the goal of at least looking at all the information that is presently available in order to know what is there ('thoroughness'). On the other there is the goal of having the necessary time and effort needed to identify and process the information that is necessary for the work at hand ('efficiency'). In the case of a disturbance, the conflict is between ensuring an adequate understanding of the situation and responding appropriately before it is too late. In general, it is the skill of detecting and keeping track of the signals in a sea of noise. The common trade-offs that people use to cope with information input overload range from reduced precision to abandoning the task completely. In between these extremes are a number of different strategies, which on the whole aim to allow the required or intended actions to be carried out as they should be or at least before it is too late.

Reduced precision: In this case it is important to reduce or compress the time spent looking at the input, but also important not to miss essential information. The solution is to scan all the input that is or becomes available, but to do it rather superficially. Even for input that is given a second look, the processing or reasoning is shallower than it should be, such as "it looks fine, no need to go further with that".

Filtering: If reduced precision is not sufficient, the next step is to filter the input by selecting some categories of inputs while ignoring the others. This is usually based on either personal experience or an agreed set of criteria in a specific work environment. The justification for excluding a category can be something like, "It is normally OK, there is no need to consider it now". This will obviously reduce the amount of information that must be looked at further, but like reduced precision it also introduces the risk that potentially valuable information may be missed.

Cutting categories: If filtering is also insufficient, the next step is to reduce the number of categories that are used. In the extreme this may result in a binary categorisation, such as "important/unimportant", "relevant/irrelevant", "safe/risky", "junk/not junk", etc. Cutting the number of categories reduces the level of discrimination since a smaller number of terms or values are used to describe the input. It may be justified if time or capacity restrictions are really severe and if it is sufficient to note only large variations.

Queuing: When it is impossible to deal with all the information at the moment, a possible trade-off is to queue it in the hope that there will be time and capacity to deal with it later. Most people have probably resorted to that solution when there have been too many new emails in the inbox. Queuing may be described as the triumph of hope over experience, paraphrasing Samuel Johnson's famous remark about second marriages. If and when the queued



items are taken into consideration, some kind of filtering is likely to be needed.

Omission: As the goal conflicts become more pronounced, so do the trade-offs used to resolve them. Simply omitting or removing certain parts of the input is a solution if it is recognised that there never will be time to catch up, hence no point in queuing. In these cases the goal of completing a task in time and without further disturbances is more important than the goal of keeping an eye on everything that happens.

The multiple minor habitual trade-offs that we learn to use serve us well, but may under certain conditions interact to produce unexpected and unwanted outcomes.

Decentralisation: In some cases, it may be possible to engage or employ additional resources to help with the input overload. An example in aviation is crew resource management which aims to make effective use of all available resources of the flight crew to assure safe and efficient operations. Generally, it requires that it is possible to activate additional resources in the situation when needed; these can be local or remote and human or technological (e.g., artificial intelligence for video surveillance).

Escape: In cases where the goal conflict between processing and responding is so serious that it seems unsolvable, the final trade-off is to escape from the situation altogether. This can either be in an actual physical sense, as in leaving the scene. But it can also be in a psychological sense by denying that a conflict actually exists, for instance by labelling it as 'fake news'. While this may bring a short-lived peace of mind to those involved it obviously does not solve the conflict, but is instead more likely to exacerbate it.

A slightly paradoxical consequence of the trade-offs to cope with information input overload is that the result may be too little information, also called information input underload. (An underload condition may also arise for other reasons, for instance that information is delayed or missing.) Just as for information input overload there are also some typical trade-offs to help deal with a lack of information, for instance extrapolating from existing data, frequency gambling ("this happens all the time"), and similarity matching ("it looks like X so it probably is X"). Solving the information input overload (or underload) goal conflict is, furthermore, usually not an end in itself but rather a means in the pursuit of other ends. Examples could be whether to continue with the current plan or modify it, whether to keep the same target or look for an alternative, etc. Whatever we do there always seems to be the need to sift through far too much information to find what is needed before it is too late. The multiple minor habitual trade-offs that we learn to use serve us well, but may under certain conditions interact to produce unexpected and unwanted outcomes precisely because they are trade-offs. While there are no easy solutions to this dilemma, we should at least try to be aware of it, and to pay more attention to the 'non-events' that are the foundation for work well done.

Post Scriptum: The concept of information input overload and the characterisation of possible coping strategies is very useful to describe the human condition in the industrialised societies in the 21st century. It is therefore remarkable that these ideas were presented nearly 60 years ago (Miller, 1960), when computers were only used by a minority of scientists and researchers, and where glass cockpits and e-mail were something no one had really imagined.

References

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