Resource : http://www.allaboutlean.com/drum-buffer-rope/

English checked by Skorkovský

USE: HOME STUDY (will be shortly mentioned during the lesson)

How Drum-Buffer-Rope Works

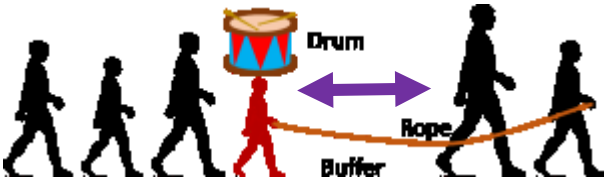
Taking these boy scouts as **an analogy for a factory** for the Drum-Buffer-Rope method as an explanation. The **drum** is the bottleneck, defining the overall speed of the system.

The system cannot go faster than the drum. Pretty much all sources on **Drum-Buffer-Rope** agree on that.

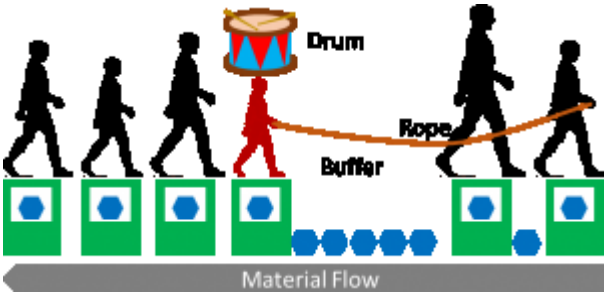
As for the buffer and the rope, well, that is where it gets a bit fuzzy.

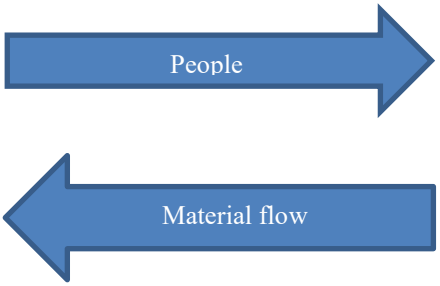
Drum-Buffer-Rope for People

Many sources take the example of the boy scout literally. The drum is the **slowest person**. The rope extends to the first person in the line, which cannot walk faster than the drum. The buffer is the **free space** between the drum/bottleneck and the next person in front of him, allowing him to walk even if the next person is temporarily slowing down (for example, to tie his shoelaces)



It may work for people, but it needs a fair bit of imagination to extend this version of Drum-Buffer-Rope to manufacturing systems. Remember that the people in this example are the **processes**, not the **parts**. The parts are the ground covered. In the image above, people walk from left to right, but the ground covered (the parts processes) would move from right to left. Hence, it looks more like the image below.





Therefore, let's take this example and put it in a proper manufacturing setting.

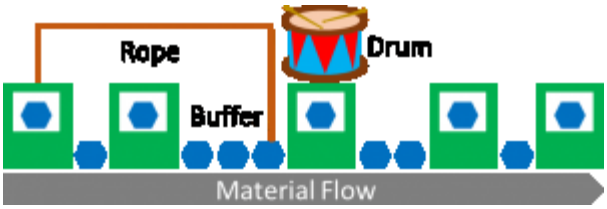
Drum Buffer Rope for Manufacturing Systems

In manufacturing, the drum is still **the bottleneck**. The buffer is the material upstream of the bottleneck and has to make sure that the drum is never starved.

TOC Step 2 and 3

The rope is a signal or information from the buffer to the beginning of the line. If the drum processes parts, the buffer moves forward, and the rope signals when the material is taken out.

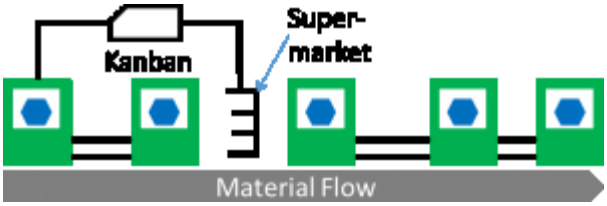
Such a signal represents information related to replenishing other parts at the beginning of the line, as shown in the illustration below.



Signaling when the material is taken out to start replenishment looks similar to Kanban.

Yes, Drum-Buffer-Rope is similar to Kanban with the supermarket before the bottleneck. When a part is taken out of the buffer/supermarket, a signal is sent via the rope/kanban to the beginning line/kanban loop to replenish material.

A Drum-Buffer-Rope system is very similar to a kanban loop, as shown below.



However, there are some differences which I would like to go into some detail below. But before that, first for completeness sake, another variant of **Drum-Buffer-Rope**, the **Simplified Drum-Buffer-Rope:**

Simplified Drum Buffer Rope (S-DBR)

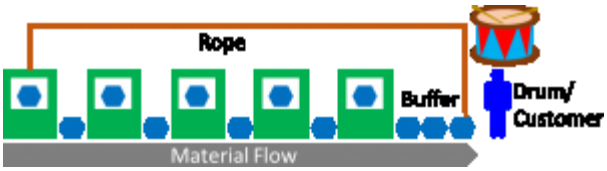
Simplified Drum-Buffer-Rope is very similar to Drum-Buffer-Rope.

The key to simplifying the approach is assuming that the **market or the customer is the most significant bottleneck.**

On average, your system always has enough capacity to satisfy demand. The rope then spans the entire length of the system.

Therefore, the buffer must be located at the end of the supply chain.

Why? Because the bottleneck is market demand.



Good Things about Drum Buffer Rope

Drum-Buffer-Rope has some underlying good ideas.

Prevents Overloading of the System

Most importantly, it does try to constrain the **work-in-progress** (WIP) and aims to prevent overloading of the system. It can be considered a sort of a pull system like Kanban or CONWIP, and therefore, Drum-Buffer-Rope is superior to the traditional push systems.

CONWIP=Constant work in progress

Furthermore, the WIP in Drum-Buffer-Rope **fluctuates less** than with Kanban.

A Kanban system defines the number of Kanban (signální karty spojené s dopravními zásobníky), consisting of the WIP (to, co je rozpracováno), the supermarket stock (to co máme ve skladu supermarket) , and the Kanban without parts)zásobníky, které jsou zatím prázdne).

Drum-Buffer-Rope (like CONWIP) is more precise as it limits only the physical parts (WIP and Stock), but does not include the variation through fluctuation of Kanban without parts.

Measuring Workload in the System as Time

Another good thing about Drum-Buffer-Rope is that it measures the work in the system not in parts but in time.

Měří práci v čase a nikoliv ve vyrobených nebo rozpracovanách kusech.

Depending on how many hours of work there are in the system, the rope may release additional parts for processing

V závislosti na tom, kolik hodin práce je v systému, může lano uvolnit další dílce ke zpracování

Text for home study

*In comparison, a Kanban system usually **only counts pieces**. In my view, counting pieces is fine if the parts are similar, as in mass production.*

*Measuring the **workload** in time may be beneficial if the items produce vastly different work content, for example, in a job shop.*

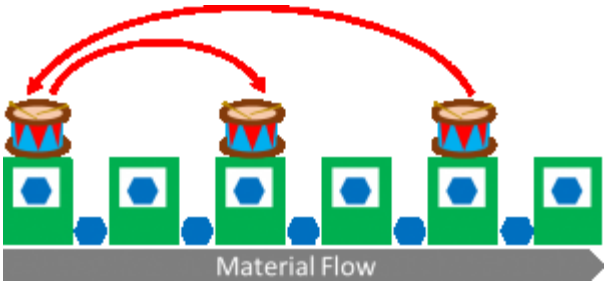
However, measuring time is also more difficult, as you need to determine the time for each product rather than merely counting them.

A Kanban system can be adapted to measure time if required, resulting in the same complexity as a Drum-Buffer-Rope system.

Flaws and shortcomings of Drum Buffer Rope

However, Drum-Buffer-Rope does have quite some shortcomings. For my daily work, I therefore much prefer a Kanban system.

No Consideration for Shifting Bottlenecks



One of the major underlying assumptions of **Drum-Buffer-Rope** is the assumption of a **fixed bottleneck.** Meaning the bottleneck does not move. If the bottleneck shifts, the drum is in a different place over time, making Drum-Buffer-Rope more difficult.

In my experience, **shifting bottlenecks** are not the exception, but the norm in most manufacturing systems, and simply assuming a fixed bottleneck will lead to problems.

This problem may be confounded that the Theory of Constraints does not offer any good approach to finding the bottleneck.

Of course, **increasing buffer sizes** will lead to minor shifting, but increasing buffers has a lot of disadvantages by itself.

Drum-Buffer-Rope considers only Starving of the Bottleneck, not Blocking of it

Drum-Buffer-Rope explicitly places a buffer in front of the drum to prevent starving.

The buffer prevents the drum from running out of material (Step 2 and Step 3 of TOC five steps rule).

However, it completely omits the possibility of the drum being blocked by a downstream process (to, co se může stat za úzkým místem), which may equally lead to bottleneck downtime (prostoj). While the buffer after the bottleneck is usually near empty, it is necessary to provide the space if a downstream process acts up and blocks the bottleneck.

Some sources of Drum-Buffer-Rope have recognized this problem and introduced a space buffer after the drum, although many other sources still omit this.

Only the Upstream Inventory matters in Drum-Buffer-Rope

Drum-Buffer-Rope controls the buffer in front of the drum and the entire inventory upstream of the bottleneck.

However, little or no consideration is given for the downstream inventory, the buffer immediately afterward, and the whole value chain to the customer.

Hence, the inventory is not limited and can still lead to overproduction under the right circumstances. Combined with shifting bottlenecks it is almost sure that the downstream stock will temporarily spiral out of control.

Text for home study

Which Part to Produce next?

A Kanban pull system constrains the total inventory and helps decide which part to produce next.

It is merely the next Kanban waiting in a line produced in the simplest case.

Hence at least for high-runners, it is clear what to produce next. Drum-Buffer-Rope does not offer much guidance. If there are multiple product variants in the system, Drum-Buffer-Rope leaves more decisions to humans with all its flaws. For example, the ***bullwhip effect*** *may lead to overproduction of some parts while others are short in supply.*

Bullwhip effect explanation (Skorkovský)

Efekt biče je fenomén distribučního kanálu, při kterém prognózy poptávky vedou k neefektivitě dodavatelského řetězce.

Jde o rostoucí výkyvy v zásobách v reakci na rostoucí výkyvy v poptávce spotřebitelů, když se člověk pohybuje dále v dodavatelském řetězci.

Efekt biče byl popsán jako sklon k tomu, že objednávky materiálu se mění více než poptávaná množství, a že tato variabilita se zvyšuje, čím dále je společnost nachází v dodavatelském řetězci“.