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WHITE PAPER

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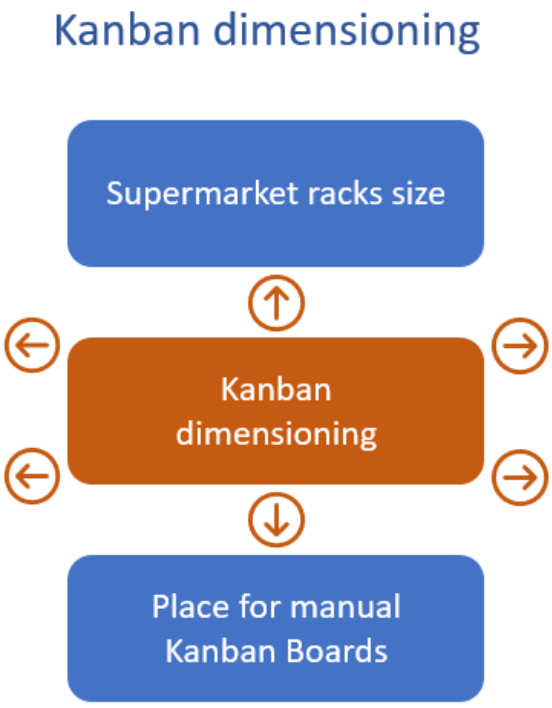

Best practice modules for a successful production Kanban

Inhalt

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Best practice building blocks for a successful production kanban

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Surveys show that almost every company uses Kanban as a control solution. However, if you take a closer look, you will find that most companies only use Kanban for replenishing assembly material from the warehouse. Usually, a two-bin solution is used there: one bin is being refilled while the assembly parts are being taken from the second bin. The refill container is back in time before the contents of the second container are used up.

The number of companies that use Kanban in production is significantly lower. Yet production kanban offers some significant advantages over the "conventional" control methods of reorder point control and MRP. Before we look at these advantages, we should take a brief look at how a production kanban system ticks:

Production kanban is significantly more demanding than the "baby kanban" of assembly replenishment. A production kanban system has to cope with different batch sizes from production stage to production stage. Despite all efforts to reduce set-up times and costs, production lot sizes in most companies are significantly larger than one piece. In production, one therefore works with collective kanban.

In the process, the incoming kanban cards are first collected by the supplying location. Only when the so-called "red area" is reached by a certain number of cards, the production of the production lot is triggered via the collected cards. To make the whole system a little smoother, a "yellow area" is usually also defined, which is already reached with a lower number of cards. From the yellow range onwards, the supplying unit may produce subsequently, from the red range onwards, it must produce.

Despite the preceding explanations, I assume that you are familiar with the mechanisms of a kanban system in general and a production kanban in particular, at least from the literature.

Stable production control

What is little discussed in the literature are the reasons why a properly implemented production kanban system works so reliably and successfully. In general, after the introduction of a production canban, material availability is significantly better, despite considerably lower inventories: In many cases, 20-30% inventory reduction is achievable.

If we look at how a clean Kanban implementation works, the success factors quickly become clear:

- The disposition parameters of a kanban system are determined carefully and not "quickly" by guesswork.
- The production capacities and the possibly fluctuating production requirements are better balanced.

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- Before switching to Kanban, potential disturbance variables are identified and largely eliminated.
- The kanban mechanism separates planning (dimensioning of the control loops) and execution (largely mechanical processing of the kanban by production). Production requirements are triggered quasi automatically and processed first-in-first-out.
- In the case of inventory limbo at the end of the financial year, kanban systems often do not depress the circulating stocks as much as items that are planned differently.
- The physical kanban mechanism copes better with the disruptions in practice than classical disposition procedures. These rely on correct book inventories in the ERP system. In the case of sloppy or late bookings - both of which are said to have happened - the classic procedures calculate with incorrect material availabilities.

The advantages of a Kanban system in production already indicate that the introduction of production Kanban is much more demanding than is generally assumed. From numerous projects we have therefore identified a whole series of best practice building blocks for a successful production kanban.

These best practice building blocks can be categorised as correct system design, correct duct bank design, correct implementation, and correct maintenance and monitoring.

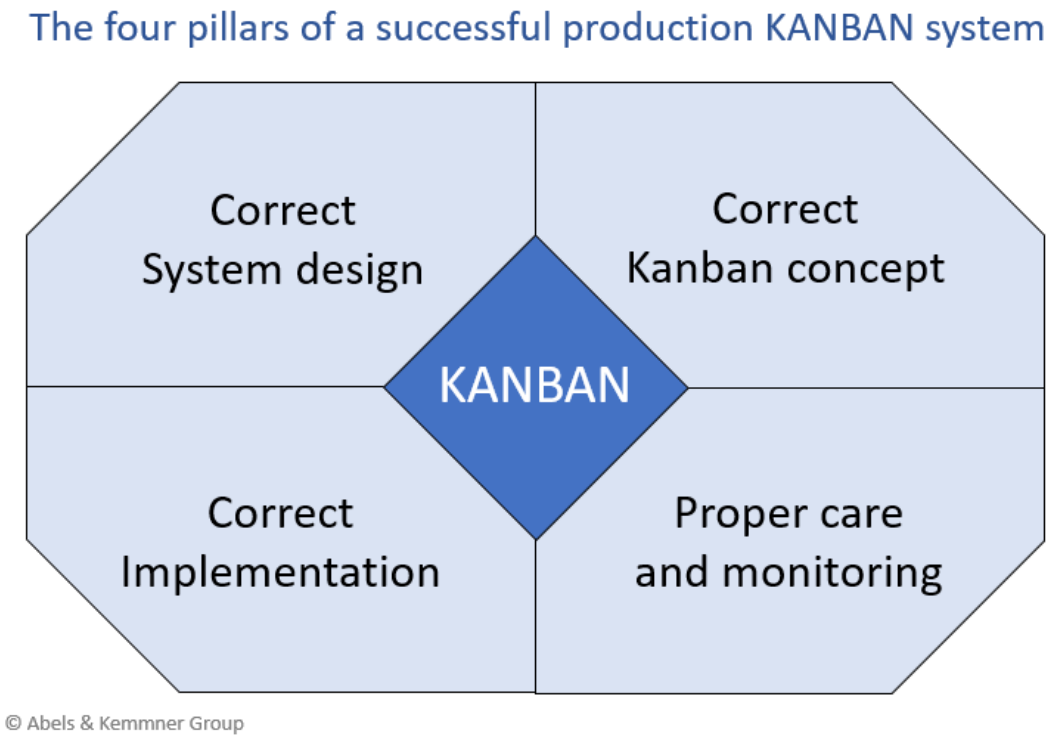


Figure 1: The four pillars of a successful production kanban system

The correct design of the Kanban system

Basic principle 1: There is a lot of brainware in simple solutions

Operating modern smartphones is (for the most part) child's play. We hardly remember that the world of smartphones was once dominated by Nokias and Blackberries before two companies from California made the phones really smart and radically simplified the complexity of operation. Behind the simple operation of today's smartphones are complex considerations, many tests and "sophisticated technology".

Numerous companies have already fallen into the simplicity trap when introducing kanban because they thought that a production kanban was as easy to introduce as a two-bin kanban. But remember: what is ultimately simple to operate and looks simple is rarely so simple in concept and production.

As Best Practice Building Block 1, we must therefore state directly: A permanently successful production kanban requires a well-considered and competent implementation

Basic principle 2: "42" is not the answer to all questions

Some heralds of lean management tend to sell you kanban as the production control principle of the 21st century. Behind this is probably the ideal of the simple life in the production world dreamed of by many. In science fiction, "42" may be the answer to all questions about life, the universe and all things. In reality, however, nowhere is there a standard answer to all the world's problems. What did you think of a plumber who wanted to fix your heating system with a pipe wrench alone? "If all you have as a tool is a hammer," sociologist Paul Watzlawick once observed, "you see a nail in every problem."

If you are striving for a sustainable and economically functioning production kanban, you should not smash your entire existing production control with the kanban hammer. It is better to concentrate on those items that are really suitable for the kanban application. First of all, demand fluctuation plays a role in kanban suitability, which is usually evaluated in logistics with the help of an XYZ classification. X and Y parts are in principle suitable for kanban.

In practical application, it has also proved useful to limit the production kanban items to the A and B parts of the semi-finished products in a first delimitation. The reason for this is the generally large number of C-articles and the resulting space problems for a conventional card kanban. A conventional card kanban can work without problems with an enormous number of kanban types - we have already introduced solutions with well over 15,000 cards, but not with an enormous number of material numbers accumulating at one supplying point. Mechanical kanban boards take up a lot of space and become very confusing. Kanban solutions with electronic automatically monitored kanban boards have no problems with this. Nevertheless, when introducing a production kanban, you should first of all stick to the principle. In addition, you are of course free to ensure that more and more of your production parts are kanbanised.

As Best Practice Building Block 2 we note: Successful kanban systems in production focus on AB/XY items.

Figure 2: The Kanban sector in the logistics portfolio

Basic principle 3: Consumption series of semi-finished products and purchased parts

Consumption series of semi-finished products and purchased parts do not always show the truth of demand.

In order to identify regular parts, one likes to analyse the consumption time series of the parts to be examined or access the existing ABC and XYZ classifications of the parts in the ERP systems. However, the actual parts consumption in the past only gives an inadequate picture of the kanban suitability. The mostly unavoidable batch sizes in production lead to the fact that even finished parts that are consumed extremely regularly cause increasingly irregular requirements and thus consumption from replenishment level to replenishment level. In the XYZ classification, this means that even components whose ultimate causes of demand flow off very regularly can have Z or even Z2 characteristics.

It is more clever to break down the consumption of the finished goods via the BOM structures without taking the production lot sizes into account and consolidate them from MRP level to MRP level. The resulting XYZ characteristic is a more reliable assessment for kanban suitability. It is true, as stated before: X and Y parts are suitable for Kanban.

Best practice module 3: When assessing kanban suitability, the fluctuation in demand of the end products is taken as a basis and not the current fluctuation in consumption of the individual parts.

Basic principle 4: Uniform consumption

Consistent consumptions are not necessarily frequent consumptions

Although you should assess kanban suitability without considering production lot sizes, in practical operation you have to live with the existing lot sizes. And so it can and will happen that you come across parts that are only produced at long intervals despite a regular final demand for finished parts. Regular requirements do not necessarily mean daily or weekly remanufacturing. The frequency with which parts have to be remanufactured depends on the ratio of demand to production batch size. If the demand is very low in relation to the production lot size, it can happen that parts only have to be remanufactured very rarely because each production lot lasts a very long time before it is used up.

Controlling such regular but low-frequency parts via Kanban does not bring you any direct advantage; the material continues to flow only in batches. Controlling these parts via Kanban, however, does not bring you any disadvantage either. Therefore, we can state:

Best Practice Building Block 4: The decisive factor for kanban suitability is the uniformity of demand, not the production frequency of a part. Large production batches in relation to the quantity demanded per unit of time do not argue against a kanban system; they only reduce the advantage of a kanban mechanism over conventional production control methods.

Basic principle 5: The world of demand keeps turning

Part of the ongoing operations in any company is that new parts are introduced into production, that old parts are discontinued and that technical changes are made to living parts. Newly started parts usually do not yet have a regular demand and parts that are being phased out no longer have a regular demand. Parts in both life cycle phases do not belong in a Kanban system.

Discontinued parts in a Kanban system were once live parts. If the demand for these discontinued parts falls continuously and the kanban control loops are regularly re-dimensioned, such production parts can only be discontinued in the kanban system if the collective kanban sizes (=production lots) are very small.

Incoming production parts, however, should only be converted to Kanban when they no longer show a growth trend.

Due to the system, a kanban control loop always lags slightly behind the change in demand for a part. If the demand for a part increases continuously, the growing demand must be served via the safety stock. If the demand continuously decreases, the kanban dimensioning pulls down the circulating stocks with a slight delay. When demand increases, the readiness to deliver suffers; when demand decreases, overstocking occurs.

In a neatly maintained kanban system, all production parts are therefore continuously monitored for their kanban suitability. Parts that are no longer suitable for kanban are removed, parts that are kanban-capable are included.

Best Practice Module 5: Kanban is Bundesliga: Here, all parts that are suitable for kanban play: Parts that no longer belong fall out and parts that qualify are added. Top Kanban performers conduct this review on a quarterly basis.

Figure 3: Example of reports for monitoring kanban suitability

Basic principle 6: Technical changes disrupt pull mechanisms

In practice, there are not only parts that are slowly phased out because demand declines continuously and comfortably. Many production parts are taken out of production abruptly without demand having declined continuously beforehand. This is always the case when, typically on the part of the sales department, a finished product, , is taken out of the range and its demand or the demand for specific production parts thus breaks off. An abrupt interruption in demand also occurs when a technical change to a part is incorporated into production at a fixed point in time.

In order to avoid residual stocks of the "old" material as far as possible in such cases, superfluous kanban types must be removed from the affected kanban control cycle and, if necessary, a residual quantity must be produced below the yellow area. This can only be done through manual intervention and targeted communication with production. De facto, in such cases the pull mechanism of the kanban system is overridden by a manual push mechanism. It therefore makes no sense to control parts with frequent technical changes via a Kanban process. Not even if the requirements are otherwise very regular.

Non-critical are technical changes to parts that do not have to flow into production at a predefined date, but rather flexibly after the remaining quantity of the old version of the part has been used up. If a flexible changeover from a predecessor part to its successor part is possible, a successor part can be introduced into the Kanban process without much effort.

Best Practice Module 6: Successful Kanban manufacturers take care not to use Kanban to control production parts that are subject to frequent technical changes with fixed change dates.

Basic principle 7: Too much of something is poison

When designing a kanban system, you will quickly come across the question of how many work steps a control loop should cover. There are companies that answer this with a very simple strategy by making each production step a separate kanban control loop.

If you have the same idea, here's the good news first: the kanban mechanism will work and ensure replenishment across all manufacturing stages.

The bad news: you should quickly expand your production area to find enough space for all the Kanban supermarkets near the respective consumers. The result of this strategy leads to a large warehouse with isolated and hidden production steps between the shelves.

Good starting points for the initial determination of the span of the individual kanban control cycles are the spans of the existing production orders. If production orders have very extensive routings at some points in production and very short ones at others, there is usually a reason for this. In our experience, it makes sense to orientate the initial conception of the kanban control cycles on the existing production orders for the different parts.

During a subsequent fine adjustment of the control loop spans, it may prove useful to deviate from the existing structures of the production orders at one point or another. For example, it may make sense to combine the same production steps of different parts into one control loop and to form a further control loop from each of the other separate production steps.

Furthermore, there should be no splitting of variants in a kanban control cycle. Unless it is a clear paired production (e.g. left side / right side) or a coupled production with stable output ratios. However, these are criteria that have mostly already been taken into account when determining the routings and thus the spans of the conventional production orders.

If possible, a kanban control cycle should not extend over several production bottlenecks. However, it does not bother much if there are other work steps before or after the bottleneck that do not have a capacity problem and over which the production lots slide without any problems.

If you are clever, you can serve several buyers (= several supermarkets) in a kanban control loop. Each customer then receives its own cards, which are collected by the supplier to form a production batch.

The more kanban control loops are connected in series in a production, the more circulating stocks have to be built up and the more sluggishly the entire system reacts to changes in demand. You can imagine the mechanism as similar to that of a queue of cars in front of a traffic light. Long after the first car in the queue has left, the last one starts moving, and long after the first car is already back at the next traffic light, the last car in the queue continues to move.

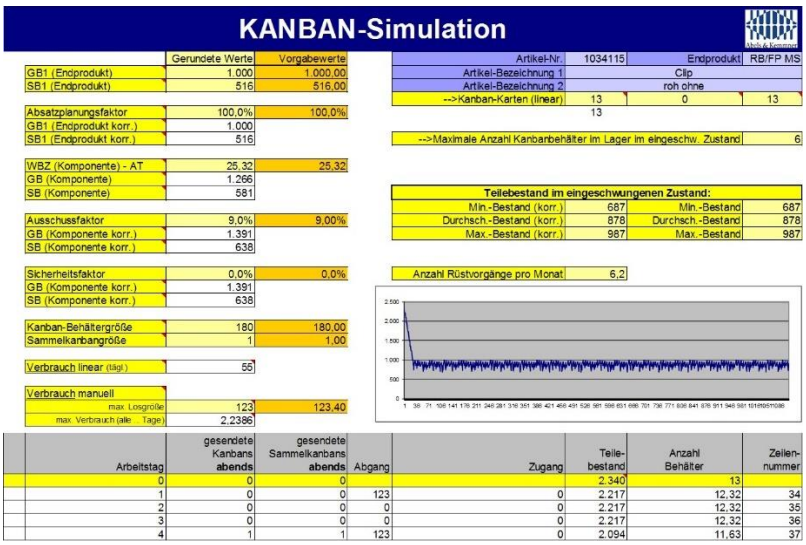
To sum up:

Best Practice Building Block 7: A professional kanban system does not set more control loops in sequence than are absolutely necessary.

Basic principle 8: There is no escaping the laws of logistics

Most Kanban textbooks make it easy when it comes to calculating the circulating stocks in a Kanban control cycle: The average consumption during the replenishment period is divided by the container size, the result is multiplied by a safety factor and "1" is added. In the case of a collective kanban, the collective kanban size must take the place of "1" (which is sometimes ignored). The safety factor in this calculation model is intended to ensure that any irregularities in demand are absorbed.

Those who design their kanban control loops in this way probably also set their safety stocks in material planning by thumb factor. However, safety stocks are subject to complex statistical laws and must be calculated cleanly on the basis of a required statistical readiness to deliver.



KANBAN-Simulation

	Gerundete Werte	Vorgabewerte
GB1 (Endprodukt)	1.000	1.000,00
SB1 (Endprodukt)	516	516,00
Absatzplanungsfaktor	100,0%	100,0%
GB1 (Endprodukt korr.)	1.000	
SB1 (Endprodukt korr.)	516	
WBZ (Komponente) - AT	25,32	25,32
GB (Komponente)	1.266	
SB (Komponente)	581	
Ausschussfaktor	9,0%	9,00%
GB (Komponente korr.)	1.391	
SB (Komponente korr.)	638	
Sicherheitsfaktor	0,0%	0,0%
GB (Komponente korr.)	1.391	
SB (Komponente korr.)	638	
Kanban-Behältergröße	180	180,00
Sammelkanbangröße	1	1,00
Verbrauch linear (tägl.)	55	
Verbrauch manuell		
max. Losgröße	123	123,40
max. Verbrauch (alle ... Tage)	2,2386	

Artikel-Nr.	1034115	Endprodukt	RB/FP MS
Artikel-Bezeichnung 1		Clip	
Artikel-Bezeichnung 2		roh ohne	
-->Kanban-Karten (linear)	13	0	13
	13		
-->Maximale Anzahl Kanbanbehälter im Lager im eingeschw. Zustand			6

Teilebestand im eingeschwungenen Zustand:			
Min.-Bestand (korr.)	687	Min.-Bestand	687
Durchsch.-Bestand (korr.)	878	Durchsch.-Bestand	878
Max.-Bestand (korr.)	987	Max.-Bestand	987

Anzahl Rüstvorgänge pro Monat	6,2

Arbeitstag	gesendete Kanbans abends	gesendete Sammelkanbans abends	Abgang	Zugang	Teile-bestand	Anzahl Behälter	Zeilen-nummer
0	0	0			2.340	13	
1	0	0	123	0	2.217	12,32	34
2	0	0	0	0	2.217	12,32	35
3	0	0	0	0	2.217	12,32	36
4	1	1	123	0	2.094	11,63	37

Figure 4: Example of a calculation programme for duct dimensioning

What applies to classical safety stocks in conventional production control also retains its validity in the calculation of kanban control loops. More on this later. For the time being, it should be noted:

Best Practice Module 8: Professionally dimensioned kanban control loops are specifically designed for a certain delivery readiness.

Basic principle 9: Assess the future

Those who do not assess the future cannot adapt to it.

Another impractical theorem that one occasionally hears in the context of lean management says that with a kanban system, demand forecasts are no longer needed; after all, the system works according to the pull principle and forecasts are only a push production issue. Unfortunately, this theorem is only half correct: it is true that forecasts are only a push production issue. However, since Kanban systems are not purely pull systems but a mixture of push and pull mechanisms, you will not be able to avoid demand forecasts if you want to set up an economically working production Kanban system.

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A true pull mechanism is only present in purely order-based manufacturing with a logistical decoupling point outside your own manufacturing and procurement. Only if you react with procurement and manufacturing only when the customer has placed an order with you do you not have to hypothesise about the future. Whenever you "prophylactically" put down stocks at certain points in the production chain in order to be able to deliver immediately, you have to think about which demands will probably come your way. And this is exactly what you do with every Kanban control cycle that you set up. The dimensioning of each kanban control cycle is based on forecasts about the expected development of demand and its fluctuations.

At best, you can do without forecasts when designing kanban control loops if you hopelessly oversize the kanban control loops and thus make them uneconomical. Therefore, we hold as a particularly important best practice building block:

Best Practice Building Block 9: A kanban system focused on delivery readiness and minimum inventory requires a good (statistical) sales forecast.

Basic principle 10: More kanban types give a better picture of the demand situation

The circulating stock of parts in a Kanban system is determined by:

- average consumption per unit of time,
- the regularity of need,
- the required degree of readiness to deliver and
- the required production lot size.

The number of Kanban containers required then depends on the number of parts that fit into a container. You need less of large bins and more of small bins.

Each container requires handling effort. This seems to argue in favour of using containers that are as large as possible. However, as the weight of a container increases, so does the force required and the technology to be used, and thus the handling costs, which ultimately again argues for several small containers rather than a few large ones.

There is another criterion in favour of using smaller containers that is at least as important as the aspect of container weight and handling effort:

The more containers circulate in a Kanban control cycle, the better the "preview effect" for the supplying area. As the card stacks in a collective Kanban system grow, the supplying area can estimate when the yellow and red areas will approximately be reached. This helps to allocate the order sequences at the production capacities in advance.

Ideally, around five kanban containers are grouped together in the collective kanban to start a production order. In practice, however, one often has to align oneself with the reality of the existing container sizes. And if the production lot sizes can be continuously reduced through set-up optimisation measures, then you cannot continuously exchange the kanban containers or keep

reducing the physical fill level of a container. The parts per container must also fill it to some extent, otherwise too much storage volume is wasted.

Many companies fear having to circulate too many kanban types with smaller kanban containers. You do not have to worry about this: the number of kanban types in a control cycle is rather uncritical. More critical can sometimes be the number of kanban-controlled items that the supplying point has to replenish. If there are too many material numbers, the overview in a physical kanban board can be lost. An electronic kanban can handle a large number of kanban parts better than classic solutions.

Best Practice Module 10: In a professionally designed production kanban system, the circulating stock of the kanban control loop is distributed to as many kanban containers as possible.

Rule of thumb: Ideally, five well-filled Kanban containers are needed for one production lot.

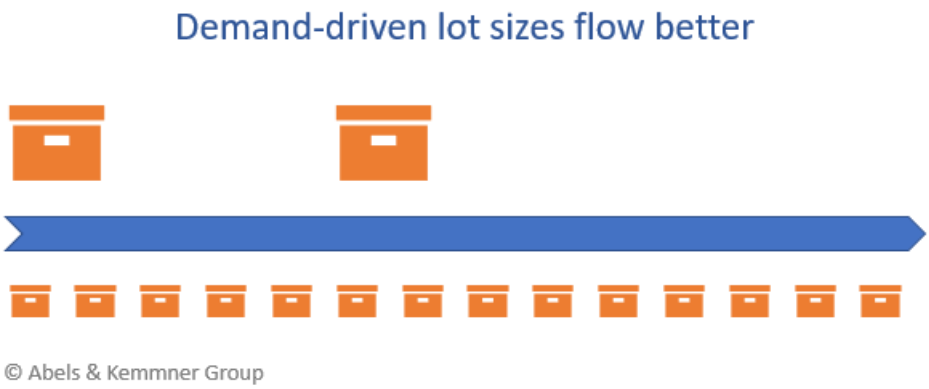

Figure 5: Many small containers allow demand and material to flow better than a few large ones

Basic principle 11: A material flow digests small batches better

Production batch sizes are barrages in the material flow that must be consistently and continuously ground. With batch size 1, the material flow would be much more even and the whip effect in the production chain would be significantly reduced.

Even if batch size 1 is not feasible for many manufacturing processes for economic reasons, the pressure for batch size reduction should be maintained.

The production kanban system can make a contribution to this, which successful companies do not do without: the standard production lot size should always be set to the "red area" and not to the beginning of the "yellow area". If production is already started in the yellow area for reasons of sequence planning or capacity balancing, the corresponding batch size is below the standard batch size.

The compromise of being allowed to start production before the actually defined replenishment threshold of the red zone is reached should be "paid for" with the batch size compromise. This builds up a certain pressure to further reduce the economic batch size.

If you do the opposite and set the standard lot size to the beginning of the yellow area, you allow production to increase the future average production lot size.

Best Practice Building Block 11: In a production kanban, the red area is at the economic batch size and the yellow area is below.

The right Kanban concept

Basic principle 12: A picture says more than a thousand tables

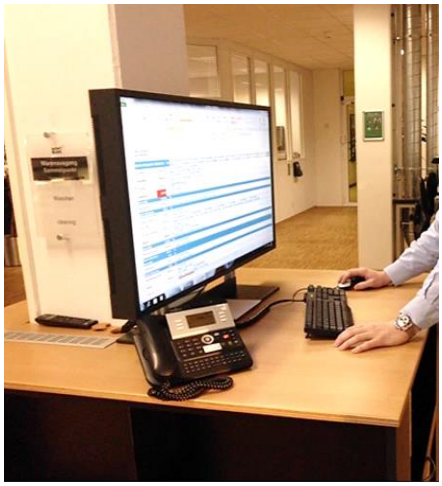

Figure 6:
Example of an electronic Kanban board

The original Kanban mechanism consists of a purely manual cycle without connection to an ERP system, which works with cards and Kanban boards into which the cards are mechanically inserted. A clear advantage of this mechanism is the simple and clear visualisation of the demand situation for the supplying unit. However, a purely mechanical Kanban system has a major disadvantage, it does not leave any "electronic traces" in the ERP system.

It can therefore neither be synchronised with other ERP-controlled scheduling processes nor can the kanban control loops be monitored centrally.

The digital version of a Kanban solution is an electronic Kanban. Here, the entire kanban control loops are managed in the computer. Corresponding solutions are available as modules or functions of various ERP systems.

Normally, electronic Kanban systems also work with physical cards, as each Kanban container must be marked. The container status, e.g. whether it is currently filled or currently empty, is communicated to the electronic Kanban system by means of a barcode scan or reading RFID information. In the electronic Kanban system, the cards and their "operating states" are kept in the computer. When a collective kanban is triggered, the cards are printed. Later, the cards of empty containers are scanned again and then destroyed, as they are now in electronic form in the Kaban software. Some companies also keep the empty scanned cards and retrieve them from the drawer when the yellow or red range has been reached, instead of printing new cards.

Electronic Kanban eliminates the disadvantages of purely manual Kanban solutions. It simplifies the management of the control loops and enables central monitoring of the kanban control loops using key figures. When re-dimensioning control loops, no one on the shop floor has to remove surplus cards from kanban boards or insert new cards.

However, an electronic Kanban also bears the risk of insufficient visualisation if the graphically prepared replica of a physical Kanban board is dispensed with.

An essential feature of the success of a kanban system is the visualisation of the demand situation for the supplying point of a kanban control cycle. You cannot achieve this visualisation with number

tables. Only graphically prepared electronic kanban boards are clear. The solutions that come closest to the original idea are those that actually depict cards and stack them on the screen.

If you want to do without a mechanical Kanban board and prefer a display on the screen, please do not economise in the wrong place. A 15-inch screen does not allow for meaningful visualisation. For the price of a physical planning board, you can afford at least a 70-inch flat screen!

Best Practice Module 12: Large-scale visualisation beats comfort: Experienced Kanban companies attach great importance to the large-scale visualisation of the demand situation in a Kanban system. It is better to manually plug in cards in a time-consuming way than to comfortably wander around in the information fog of electronic solutions without graphic Kanban visualisation.

Basic principle 13: Modern leadership takes place at the scene of the crime

In the Toyota Production System, we speak of "Gemba". This Japanese term is perhaps best translated as "crime scene". Investigating at the scene of a crime, as we know as avid crime readers and crime watchers, is essential for the inspector. The detailed documentation of the crime scene by forensic science can never replace walking the crime scene. At the crime scene, a lot of secondary information is recorded that completes the impression. Even with the most careful documentation, only part of the information that makes up the crime scene can be recorded.

The same applies to decentralised control, as established by a Kanban system. The people on the ground, the people at the scene, know and grasp many connections that are difficult to discern from a desk. This also - and already - applies to the desk of the foreman or the production controller. A Kanban board belongs at the scene of the crime of the supplying, post-production unit and not in the foreman's office; regardless of whether it is a physical Kanban board or an electronic variant.

In any case, the board must be positioned so that it is large enough and visible enough that those who trigger collective kanbans work in the light of day. Secret knowledge of the foreman or production controller was yesterday - Kanban takes place in public. This publicity is part of the "checks and balances" that help to ensure that the system works reliably and that the rules are followed.

Best Practice Module 13: A Kanban board - mechanically or electronically designed - belongs in production and not in the foreman's office.

Figure 7: Example of a conventional Kanban board

Basic principle 14: Kanban parts and conventional parts

Separating kanban parts and conventional parts in terms of production technology is rarely economical.

In companies with a typical product structure, 40% to 80% of the production capacity is occupied by 10% to 30% of the regular production parts (AB/XY parts). The remaining 70% to 90% of the material numbers have only irregular requirements and occupy the remaining production capacity. If you convert the AB/XY parts to Kanban and continue to control the remaining parts conventionally, you will hardly succeed in assigning separate production areas and equipment to the two groups of parts.

Separating kanban parts and conventional parts in terms of production would require overcapacities in both segments and would therefore not be economical. We regularly come across companies that assume that kanban parts have to be produced in a separate kanban production. Since this is not economically feasible, they unnecessarily forego the introduction of kanban.

While the operation of a Kanban system ideally requires spare capacity or, alternatively, complementary levelling measures, it does not require the physical separation of manufacturing areas in Kanban and the rest of the world.

Best Practice Module 14: In economical Kanban solutions, kanban-controlled and conventionally controlled items largely run over the same capacities.

Basic principle 15: If nothing pulls, nothing is pushed

The magic of a Kanban system lies in market-synchronised production. Nothing should be produced in advance if there is no demand.

However, absolutely consistent demand-synchronised production requires great flexibility in production to cope with fluctuations in demand. This flexibility costs money, because it is usually only achieved through reserve capacity or additional shifts in the production facilities and a higher number of permanent and temporary staff.

As far as staff are concerned, a certain degree of flexibility can be achieved by assigning staff to other workplaces and by using flexitime and working time accounts.

The yellow area in a production kanban as well as the levelling of production through a heijunka mechanism also allow the demand side to be smoothed somewhat.

However, it happens from time to time that all these adjustment mechanisms are not enough and idle time among the employees and under-utilisation in production are imminent. The company then quickly calls for pre-production. However, a professionally designed kanban system must be able to withstand temporary idle time among employees. Pre-production beyond a clearly defined levelling mechanism is not an adequate response. It leads to overstocking, can at best postpone under-utilisation, because at some point the overstocks have to be reduced again, and carries the risk that fluctuations in production utilisation will increase further. In professional kanban systems, therefore, there is no way around it:

Best Practice Building Block 15: A consistent kanban system must be able to withstand occasional idling of staff.

Proper introduction

Basic principle 16: Convince before force.

When introducing a kanban system, you will not only meet with enthusiasm. The reservations about a pull system are manifold and deeply rooted. We have made the experience again and again that especially masters in production approach kanban systems with caution. Behind this is the doubt whether such a pull system can really work and is so much more effective than a classic control mechanism.

Sometimes there is also the uncertainty of "having to" decide on the next order to be produced within the framework of decentralised control, and no longer having this decided by a production controller.

If we encounter such reservations in the preliminary discussions, we recommend conducting a business game to prepare for the introduction of Kanban.

Different business games are offered on the market. We like to use a business game in which we simplify the production processes step by step and change the control principle over the course of two days, starting from a planned production according to sales specifications.

While at the beginning the participants do not fulfil the given production plan despite great stress, at the end of the business game they manage to do so strikingly quickly and easily using Kanban.

Best Practice Building Block 16: A business game can be the beginning of a wonderful friendship between users and a kanban system.

Figure 8: Business game for the preparation of a Kanban introduction

Basic principle 17: The master is always right

When designing a kanban system, one eventually reaches the point of discussing the calculated control loops with the foremen or area managers of the various production areas. Often the contact persons doubt that the control loops are sufficiently dimensioned. What happens if several parts that have to be produced on the same machines go "red" at the same time? The abstract hint that this rarely happens in practice and can be intercepted by the defined yellow areas and the safety stocks in the individual control loops is often not enough to dispel the reservations.

In these cases, agree with the foremen on a lead time by which you extend the replenishment time of the control loop and which is set in such a way that the foremen are convinced that they will be able to produce the parts in time. Keep this lead time separate from the actual replenishment time. The lead time does require you to build up a little more inventory than your control loop actually requires. But you have the master on your side. Through the lead time, sometimes negotiated like at the bazaar, the foreman has committed that the Kanban-

The result is that parts in the supermarket/ Kanban shelf can be replenished in good time.

If the Kanban system is running, you will be able to tell from monitoring the replenishment time whether the lead time is necessary. If it is not necessary, you can continuously reduce it in consultation with the masters. If, exceptionally, it is indeed necessary, you have just benefited from the experience of the foreman. The goal must be to continuously eliminate lead times that are not necessary.

Best Practice Module 17: Better "lead times" than reservations: A successful Kanban implementation takes seriously the reservations of the foremen who will later have to live with the Kanban system. Additional security in the control loop in the form of a "lead time" can dispel reservations.

The lead time must be documented separately and must not be hidden in the replacement time in order to precisely separate clean control loop calculation and subjective safety perception.

Basic principle 18: Inventory reduction is good, but delivery readiness is better

Decide spontaneously: In the first four weeks since the go-live of a Kanban system, how do you measure its success: parts availability or inventory reduction? If you decide like most people, then initially parts availability is more important to you than inventory reduction. The fact that it takes time for stocks to run out is more readily accepted than that it takes time for sufficient stocks to build up in a new kanban control loop.

To avoid any doubts about the possible success of a new Kanban system in the first place, you should never start "from an undersupply". If possible, only switch a part to Kanban when you have built up the necessary supermarket stocks. If a kanban control loop is not able to deliver as planned, doubts about the reliability of the entire system quickly arise.

Kanban control loops with initial overstocks are not a significant problem. Provided you have selected the right range of parts for your kanban system, the overstocks will drain away quickly.

Best practice module 18: Front water against kanban haters: Companies that have experience with the introduction of kanban systems always start their control loops with sufficient stocks or from excess stocks, if possible.

Despite the focus on delivery readiness, a kanban system is rightly expected to be able to reduce stocks significantly. This is almost always true, which leads to Basic Principle 19.

Basic principle 19: 30% are usually in

Experience shows that in a well-established kanban system it is quite possible to save 30% inventory. At first glance, this may seem surprising. A well-constructed planning-controlled disposition should actually be able to manage with less stock than a Kanban system.

This consideration is essentially correct. Provided that for parts with a regular demand, a planned disposition is really well designed and all disturbance variables are eliminated, then a stock level can be realised that cannot be achieved by means of a kanban system. A just-in-time production represents such a precisely designed, plan-controlled disposition. Since, unfortunately, not all disruptions can be avoided in practice with a reasonable amount of effort, empirical evidence shows that significant inventory reductions can be achieved with kanban systems.

Two other effects also contribute to the stock benefits of a kanban system:

1. Kanban systems are insensitive to booking errors, because a kanban system is controlled according to the physical stocks. If a box is empty, the kanban card goes back to the

supplier, inventory differences between book stocks and physical stocks do not disturb a kanban system.

2. Kanban systems generally do not suffer as much from the dubious inventory limbo that takes place in many companies at the end of the financial year or even quarterly. On the one hand, because a kanban system is more cumbersome to run down stocks in numerous control loops, only to run them up again massively a short time later. On the other hand, because with kanban control loops one is more sensitive with regard to their delivery capability.

Best Practice Module 19: In order to fully exploit the potential of inventory reduction, successful Kanban companies attach importance to a careful and sustainable Kanban implementation. A key success factor is the consistent elimination of disruptive factors.

Basic principle 20: Think first, then act

When Filippo Brunelleschi began building the dome of Florence Cathedral in 1420, he did something radically new for his time and thus became a pioneer of modern work organisation: he separated planning from execution. Only in this way was it possible for him to realise the most massive dome construction since antiquity.

The principle of thinking first and then implementing has since prevailed in the world - and also among good craftsmen.

Why is it that many Kanban implementation projects then start by selecting a first pilot control loop and diligently laminating cards? There seems to be a great fascination with laminating Kanban cards.

Even if a kanban implementation is not a millennium achievement, it also makes sense here to separate planning and execution.

The first step in designing a Kanban system is to check and correct the required master and movement data for calculating the control loops. After that, it is first necessary to dimension the entire control loops.

The calculation of the control loops is the starting point for designing the entire kanban infrastructure: starting with the required size of the supermarkets, the required area of manual kanban boards and the determination of suitable container sizes, to the calculation of the required number of kanban containers as well as the verification of capacity utilisation

Best Practice Module 20: Study before laminating: A successful Kanban implementation first of all has a lot to do with calculation and thinking and little to do with laminating cards.

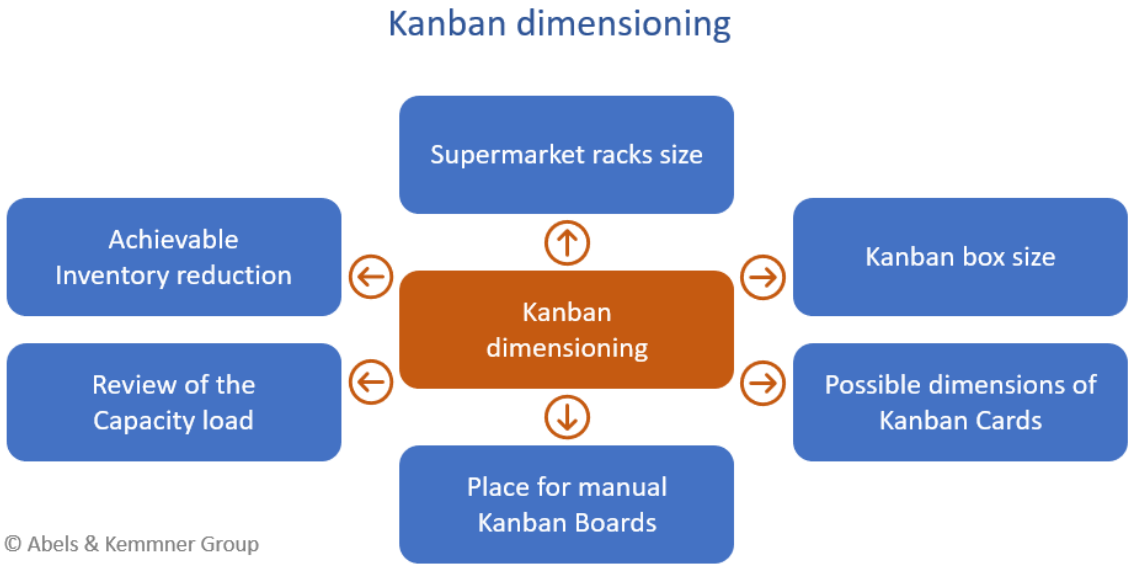

Figure 9: The dimensioning of the kanban control loops is the basis for the entire design of the kanban infrastructure

Basic principle 21: Sustainable success requires sustainable training

Precisely because a kanban system seems so simple, many companies think they can get by with a quick training of the staff. This is a fatal error that has caused many a kanban system to fail.

It is not enough to train employees like Pavlovian dogs with reflexes to perform "their" Kanban step. When problems arise in the Kanban process, employees should be able to make correct decisions and not improvise incorrectly. This only works if everyone involved in the kanban system understands the overall mechanism of the kanban system.

Even someone who only removes parts from kanban boxes and places the kanban card of an empty container in a "letterbox" or scans the card must know the significance of the correct execution of his work step for the entire process.

Besides the careful dimensioning of a Kanban system, no other factor contributes as decisively to the sustainable success of a Kanban system as the training of the employees.

In our Kanban implementation projects, we attach great importance to training all employees in all Kanban steps. Those who have understood the entire Kanban process are also able to understand the effects of their actions on the Kanban control loop. From the analysis of numerous Kanban systems, we can clearly state:

Best Practice Building Block 21: In companies with sustainably successful Kanban systems, all employees involved with the Kanban system have received comprehensive training.

Basic principle 22: Pull mechanisms require capacity reserves

The effect that the performance of the system decreases beyond 85% utilisation of the storage capacity is known from automatic high-regulation warehouses. Presumably, this effect also occurs with the utilisation of production capacities beyond 85%. Unfortunately, it does not show up as clearly in the normal interaction of many production capacities with each other. The costs caused by frictional losses seep into many cost centres without the relationship to capacity overload becoming clear. If production capacities that are passed through by kanban control loops are overloaded, this has an immediate effect in the form of a longer production lead time and thus a longer replenishment time.

An occasional short-term extension of the production lead time can usually be absorbed by the safety stocks of the kanban control loops. However, if the duration and severity of the bottlenecks increase, the delivery capability of kanban control loops can quickly collapse. To prevent such cases, capacity bottlenecks should ideally be avoided. In many cases, this is feasible through flexible working hours and shift extensions, but rarely as quickly as the capacity bottlenecks occur.

In order to maintain the delivery capability of the kanban system in such situations, heijunka mechanisms must be used or replenishment times must be extended in good time and with foresight. In both cases, however, the delivery capability of the kanban control loops is bought with increased kanban stocks. These can only be avoided by making production capacities more flexible, but this generally costs money.

Best Practice Building Block 22: Companies that attach importance to the performance of their Kanban systems make sure that the capacity utilisation of production does not exceed 85%. At the capacity units where this target value cannot be met, production is levelled by means of Heijunka.

Proper care and monitoring

Basic principle 23: You can't judge what you don't monitor

"What actually happens if we lose kanban types? Surely that can hardly be ruled out in practice!", this is a typical reservation you almost always encounter when introducing Kanban solutions. If the employees are well trained and the kanban board is set up in a clearly visible way, this happens far less often in reality than is feared. Nevertheless, the loss of kanban types in a purely conventionally designed and not electronically monitored control loop poses a serious threat to the delivery capability of the control loop. In reliable kanban systems linked to the ERP or PDA system, card losses can be easily detected. Cards that have been lost no longer experience status changes (full/empty/etc.). This can be automatically evaluated and reported.

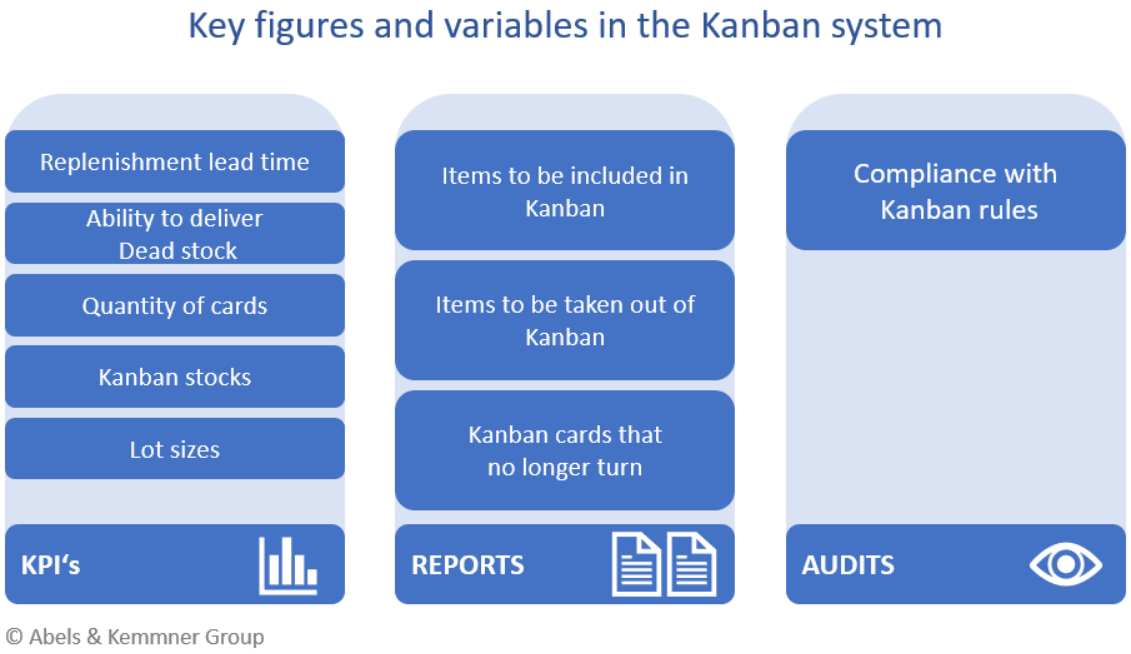

Figure 10: Key figures and parameters in the Kanban system

In the same way, the replenishment time from reaching the red zone to the delivery of the collective canteen lot in the supermarket can be evaluated or the delivery capability of the control loop can be logged.

In a purely manually designed kanban system, many things cannot be controlled, and some things can only be controlled in a time-consuming way using tally sheets: an absolute NO-GO in modern kanban systems, which are designed with the claim of working economically and in a way that protects the stock.

Only continuous monitoring through appropriate reporting ensures the quality of the kanban master data and the discipline of the system process.

Best Practice Building Block 23: In successful Kanban systems, the control loops are continuously monitored with regard to replenishment times, delivery capability of the control loops, compliance with Kanban rules, dimensioning of the number of cards, Kanban stocks.

However, the best evaluations are of no use if they are based on the wrong figures. In order for your controlling to work, you should observe basic principle 24.

Basic principle 24: Clean measurement points are the basis for clean key figures

The replenishment time is a very sensitive parameter in collective Kanban control loops. As already mentioned, the replenishment time used in a collective Kanban system is measured from the time the red zone is reached until the collective Kanban lot is delivered to the supermarket.

Setting a kanban card to "empty" does not initiate production in a collective kanban system. The card moves (manually or electronically) into the kanban board and dozes there until the card stack has risen into the yellow area or has reached the red area.

Only then does production start and only then should the stopwatch for measuring the replenishment time start. You can normally stop reaching the finish line by setting the kanban cards "full". However, you do not record the starting point of the replenishment race with the "empty" scanning of a card.

Therefore, as a small but significant building block, we have to note:

Best practice module 24: In order to be able to cleanly determine the replenishment times in a collective canteen system, scanning must normally be carried out three times. In addition to "container empty" and "container full", scans should also be carried out again at the start of production.

Monitoring a kanban system does not stop with tracking operational metrics. Another basic principle that your kanban system must observe.

Basic principle 25: demand-oriented production

If you want to produce according to demand, you also have to orientate yourself to demand.

If you want to limit the operation of your Kanban system to those items that have no demand fluctuations, no seasonalities and no trends, you will only operate with a handful of parts for which Kanban is not profitable.

The days when a Kanban control cycle was calculated once for all are long gone. In companies that were professional in terms of Kanban, clean calculations were also carried out in the past. However, conventional formulas for Kanban calculation make it almost impossible for you to consistently design your control loops to achieve the required delivery readiness with the lowest inventory. This is because fluctuations in demand are mathematically ignored and only taken into account via a belly factor. If you were too low with the belly factor, you would notice this during operation because your supermarket would suddenly be empty. If you were too high, you were always able to deliver and happy, but unnoticed with too much stock.

The correct design of a kanban control cycle works in the same way as the statistical calculation of a reorder level. As with the reorder level calculation, the required delivery readiness and minimum and maximum lot sizes must also be taken into account when designing kanban control loops. Basically, a kanban control cycle is an alternative form of mapping a reorder level system.

If you want to design your safety stocks correctly in both cases, this requires more mathematics than your ERP system probably uses in a statistical calculation of the reorder level.

The reason for this is the so-called "non-normally distributed demand". However, this discussion would go too far here. For further information, please refer to the article "Best practice building blocks of sales forecasting".

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The mathematical re-dimensioning of kanban control loops is not a major effort, provided that the system in which the recalculation is carried out is supplied with the required consumption time series by your ERP system.

The second step of re-dimensioning, the operative adjustment of the number of cards circulating in a control loop, does not cause much trouble, at least with electronic kanban systems. You should always re-dimension your control loops on a monthly basis. Even if this requires some running through production to pull out and insert kanban cards at the panels.

There is a hard best practice criterion for modern, high-performance kanban systems:

Best Practice Module 25: In efficient Kanban systems, control loops are re-dimensioned on a monthly basis.

Even if the demand quantities per time unit and the demand fluctuation remained constant, you would have to regularly re-dimension your kanban control loops and take into account changes in replenishment times and production lot sizes, which hopefully are being worked on diligently, because this is where the following point takes effect.

Basic principle 26: A kanban system alone does not bring about continuous improvement

Kanban systems are a building block of lean management. The central mechanism of lean management is the continuous elimination of waste (Japanese "muda"):

Transport, high inventories, unnecessary movement, waiting time, overproduction, incorrect work processes/ technologies and production errors or rejects/rework. As a rule, these types of waste are interdependent. For example, overproduction leads to increased inventories, which cause higher

transport costs. In addition to these 7 types of lean, two types can be added, depending on the organisation: "unused creativity of employees" and "procrastination of decisions and projects".

Whether or not you have anything to do with lean management, you should definitely focus on the potential of a continuous reduction in replenishment times and batch sizes so that your Kanban system becomes a best-practice solution. A nice effect: if you regularly re-dimension your Kanban system, you can measure the benefits of the improved logistics parameters directly in monetary terms in the form of lower stocks in circulation.

Best Practice Building Block 26: For the most efficient Kanban systems, work is continuously being done to reduce replenishment times and the required production batch sizes.

If you diligently implement the best practice building blocks presented, you are well on your way to building a powerful and exemplary Kanban system. To ensure that your efforts are also sustainable, you should observe another basic principle that can not only destroy kanban systems.

Basic principle 27: Human negligence

Human negligence reliably erodes any organisational and technical system.

Let's face it: to a certain extent, we all tend to be nonchalant about existing rules and laws. Some people and some countries more so, other people and other countries less so. Nothing in life is eaten as hot as it is cooked and no rule is followed as closely as it is intended to be.

Because Kanban works so amazingly simply, one often assumes that it is also correspondingly easy to introduce in the company. Unfortunately, this is far from the case. Just as you can't dimension a Kanban system sloppily, you can't handle it sloppily.

There must be clear rules for everyone and everyone must abide by the rules. This is the only way to ensure that everyone works together successfully and that all the wheels of the Kanban system mesh neatly.

But no organisational process, once set up, remains perfect for all time. The rules and regulations of a kanban system must also be adapted to changes in the company at certain points. However, this should not be done silently by the employees. Problems in the processes must be discussed and, based on this, alternative processes coordinated and tested. If the tests are positive, the rules should be changed accordingly, otherwise the old rules are reverted to. Defining clear standards is also a building block of lean management, but was also taught by REFA 50 years ago.

A good example of such rule optimisation, which has already become "standard", is the "yellow area" in a collective canban system. It allows a deviation from two basic principles that actually have to be strictly adhered to:

- Never request more material than is necessary and never request material prematurely;
- Never produce more parts than requested and do not produce before requested.

The "yellow range" deviates from these basic rules. By allowing a production to start as soon as the yellow range of kanban types is reached, one allows a light but clearly defined pre-production.

In practice, this control deviation has proven to be so useful that it is now part of the standard mechanism of every collective canban system and the term "traffic light canban" (green / yellow / red area) has become established.

In practice, unfortunately, we see time and again that Kanban rules are interpreted very generously. An efficient Kanban system is not possible in this way.

To ensure that the rules are adhered to, you can start at different points. If you set up the monitoring of replenishment times cleverly, you can also see from the data whether returned kanban types have been quickly added to a running production order or whether they have been added to the kanban board in accordance with the rules in order to form the basis of the next production lot.

Whether all organisational processes and rules are adhered to can ultimately only be checked by means of an audit.

Best Practice Building Block 27: The performance of a kanban system is only maintained if compliance with the organisational procedures and rules of the game is regularly checked in audits.

Since human negligence is so pleasant and so dangerous, you should observe another basic principle, especially in a young Kanban organisation.

Basic principle 28: Education requires consistency

Fatalistically, change management can be compared to raising children: It takes 18 years and still sometimes goes wrong.

Besides many causes that cannot be influenced, there are two levers that must be actively addressed: clear rules and consistency.

Regarding the "rules", we have already identified a best practice building block. We still need to talk about the consistency, because despite audits you will hardly be able to enforce that all defined rules of the Kanban mechanism are always fully complied with.

Do they still remember their driving school days? We would probably all fail the driving test today, because in practice we apply some rules more generously than we had once learned them in the first place. It takes some driving experience to understand which rules of the road you have to strictly follow and which ones you can be a bit more generous with in practical driving behaviour without endangering yourself and the traffic. The driving school instructors' insistence has ensured that we have not only learned the rules and regulations, but have also internalised them and largely adhere to them.

It is the same with a Kanban system: With growing experience in handling a Kanban system and growing understanding of the Kanban mechanisms, you can optimise rules or handle certain rules more generously. However, the latter inevitably leads to chaos if the kanban rules are not internalised. Once the Kanban compass of the employees is calibrated, deviating from the rules automatically causes a guilty conscience and always pulls everyone back to the path of virtue.

The American psychologist Anders Ericcson came up with the 10,000-hour rule. This states that you have to have worked on something for 10,000 hours in order to master it at a world-class level, assuming you are talented.

When you have mastered a task over and over again for 10,000 hard hours, then mechanisms have become second nature to you that you adhere to without having to think.

In our experience, this principle also applies to Kanban. Compliance with rules must be consistently monitored and demanded over a period of time so that employees internalise them. Once a behaviour has been internalised, once we are "calibrated", it causes us a certain discomfort if we deviate from the path of internalised virtue. We have encountered the "educational" consequence time and again in successful Kanban companies.

Best Practice Building Block 28: In a Kanban organisation that is to remain sustainably efficient, all rules should be strictly adhered to without tolerance in the first 12 - 18 months in order to internalise the rules. If possible, start optimising processes only afterwards.

Basic principle 29: Every "system" needs maintenance and care

The decentralisation of production control is an essential feature of a kanban system. Some companies therefore think that they can do away with production control by introducing a kanban system, but a production control function is still needed even in a kanban system. However, the task of a production controller in kanban parts differs significantly from the task in a classically organised production system.

In the kanban mechanism, planning and execution are separated from each other. Production control is responsible for maintaining and regularly re-dimensioning the kanban system, while production itself makes the operative decision relevant to MRP. In a Kanban system, no parts or deadlines are chased. The entire Kanban mechanism is designed and calculated from the beginning and is re-dimensioned in such a way that this is not necessary. The classic production control mechanism, on the other hand, is often still craft-oriented and more concerned with eliminating disruptions than with systematically avoiding them.

When introducing kanban systems, it is tempting to reduce the production control effort to well below 50% and initially this seems possible without causing problems.

After some time, however, you will notice that stocks increase and/or parts and deadlines are chased again. In this case, either the effort in production control increases significantly again, or the kanban system gets out of hand.

Only in a well-maintained kanban system can the potential faults be sufficiently compensated and thus relieve the production control.

Best practice module 29: Companies with sustainably successful kanban organisations give production control sufficient time to maintain the control loops and therefore reduce the production control effort for the kanban parts by a maximum of 50%.

CONCLUSION: Kanban is worth the sweat of the nobles

We had to compile many, sometimes very detailed best practice building blocks for the production kanban, which is so simple and transparent after all. How important these many aspects can be perhaps becomes clear when we point out one last basic principle:

You only have the chance to introduce Kanban once every 10 years.

If you have "screwed up" the introduction of new organisational processes, it takes some time before you can try again without directly encountering resistance from those affected. In the case of Kanban implementation, the time needed to let the grass grow over the matter seems to be particularly long.

However, if you make the effort to carefully implement your production kanban and approach the project with the ambition of achieving an exemplary solution, you will be rewarded with a cost-effective, economical and stock-saving replenishment mechanism.

Kanban is worth the sweat of the noble!