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PRODUCTION ORDERS AND PRODUCTION RUNS: AN OVERVIEW

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ABSTRACT

An overview is given of the different types of production orders that are met in practice based on a number of characteristics of production processes. Attention is paid to the logistical aspects and informational requirements related to the usage of each of these orders. The role of production orders as a unit for time-phased resource planning is compared with the usage of production runs.

INTRODUCTION

This paper deals with production orders and production runs, two important quantities used for planning, releasing and controlling the progress of work in a production facility, where the latter may denote an operator as well as a network of plants.
How work is planned, released, and controlled primarily depends upon how the products are produced or materials are processed; i.e. the (sequence of the) operations (processes), the set of resources used for the execution of each of these operations, and the relative physical positions of these resources. Notably the uncertainty with respect to the timely availability of the resources, the duration and the results of the execution of processes with respect to timeliness, quantity and quality, but also the method of cost accounting (resource usage registration, work-in-process progress registration) strongly influence the three above mentioned activities.
One may expect that the above mentioned aspects of the prodution environment determine the types of production orders and runs used for planning, releasing and controlling the progress of work.
In the following it is assumed that the set of products to be produced, which may denote the production of material products as well as the supply of immaterial services, as well as the (sequence of the) processes and the sets of resources required for their execution are given.In this paper relationships are established between how work is executed, i.e. the characteristics of the set of processes involved, the set of inputs required for and the set of outputs resulting from the execution of these processes, inclusive information, and the different types of production orders and runs met in practice.
These relations are notably useful for getting insight into the logistical consequences and specific information requirements resulting from the usage of each of these types of orders and runs in different production situations.
Although in literature some attention has been paid to some of these relationships for production orders, see e.g. (Kimball, 1987), (Wight and Landvater, 1983), a general overview is still missing.
The purpose of this paper is to provide at least part of such an overview.

The setup of this paper is as follows.
In the first part of the paper first a number of aspects of operations are discussed that strongly influence the logistic control of work.
Hereafter an overview of production orders presently used in practice is presented and

relations are established between these orders and the above mentioned aspects of operations. Attention is paid to both the logistical aspects of each of these orders and the specific information requirements resulting from the usage of these orders.
Many companies use production runs instead of, or apart from, production orders as units for planning work. In the second part of this paper the logistical aspects of production runs as well as their specific information requirements are discussed and related to the considered characteristics of operations.

In the third and last part of this paper the similarities and differences between production runs and production orders are discussed both from a logistical and an informational point of view. Based upon this discussion the potential advantages and disadvantages of using production orders instead of production runs are summarised for a number of characteristic production situations.

PRODUCTION PROCESSES

Having decided on the set of products to be produced, the (sequence of the) processes and the sets of resources to be used for the execution of these, the next thing to be considered in order to decide upon how work is to be planned, released and its progress controlled, are the characteristics of the individual operations, as well as the inter relationsships between these operations. Thereby an operation denotes a process, the set of inputs required for its execution, the values of the set of process parameters, like setup and rate, as well as the set of outputs resulting from the execution of the process using the set of inputs.

Within this context it is important to distinguish between processing and producing. Processing is related to a transformation of the set of (im)material inputs, whereas producing is related to the set of (im)material outputs resulting from the execution of a process (transformation) using a given set of resources and a given set of process parameters, including setup and rate. One may say that processing represents an input based point of view on processes, whereas producing represents an output based point of view.
Processing and producing coincide if the (im)material semi-finished products making up (part of) the set of (im)material inputs are "only changed" by the transformation, like in the painting of metal parts.

Simultaneous versus sequential processing/production.

In this paper "simultaneously" indicates the usage of the same set of resources at the same time for the production of a number of copies of one or or a number of products (article codes). Thereby a resource may be a material, a machine, an operator, a tool etc. Examples of products that are processed according to the above restrictive definition of simultaneously are e.g. cookies, cardboard boxes, blistercards, whereas the refining of oil results in the simultaneous production of gasoline, gasses etc.

A less restrictive definition of simultaneous processing/production denotes the usage of the same set of resources during the same time-interval, where a resource may denote all or part of the available machines of a specific type, like a number of paralel wise working machines, or an entire production unit like an assembly line or department.

Sequentially processing/producing means that different products are not using the same (set of) resources simultaneously.
In case the production/processing of different products requires the same set of resources, sequential production means that different products will be produced one after another.

Whether or not products are produced or processed simultaneously depends on technical restrictions, for instance related to the method of processing, the set of resources used, which applies for instance for the production of so called by-products or co-products (alternate-quality product), see e.g. (Campbell, 1988) and (LaDuke, 1989), but is primarily based on economical arguments, like preventing an uneconomical usage of resources.

Multi-product versus single-product processing/production.

In the foregoing sub section we distinguished already between the simultaneous and sequential processing/producing of a quantity, or number of copies, of one single product (article code) or quantities, or one or a number of copies, of a number of different products (article codes).

As mentioned in the introduction of this paper, one of the aspects to be taken into account are the number of different products that (may) result from the execution of a given process; i.e. the output side of the processes.
Strictly spoken the execution of whatever process results in a set of outputs including both desired and undesired products.
From a technological point of view there do not and will not exist processes that result in one single output.
From an economist's point of view undesired outputs are not explicitly token into account if they do not contribute "significally" to the income or expenses of a company however. This point of view is usually taken in defining a process. Due to still growing environmental problems still more outputs will (have to) be registered due to rising costs in exposing these or to legislations.

Combining the above mentioned ways of processing/producing we arrive at the following table, giving for each combination an example.

	Sequential	Simultaneous
Single product (article code)	Television set	Cookies paralel on a belt
Several products (article codes)	Car painting (multi model or mixed model)	Blistercards, Oil refining Group Technology Cell (co-products)

TABLE I : PROCESSING METHODS

The rows "Single product" and "Several products" in Table I indicate that the processing activities are primarely set up in order to produce one or a number of copies of one respectively a number of different (semi-)finished products. So Table I presents an output oriented sub division of processes.
(An input oriented sub division of processes would give rise to the same table however.)
For definitions of mixed and multi model production see for instance (Wild, 1972).

Assembly versus disassembly processes.

Another sub division of processes that is important with respect to the planning, release and progress control of work concerns the following relation between the set of material inputs required for the execution of a process and the set of material outputs resulting

from the execution.
If ni denotes the number of different article codes in the set of material inputs required for the execution of a given process, whereas no denotes the number of different article codes in the set of material outputs of that process, then assembly activities are characterised by a tuple (ni,no) where ni<no, whereas disassembly activities are characterised by tuples (ni,no) where ni>no.
Examples of assembly processes can among others be found in the production of cars, chairs, ships, flavored mineral water etc.
Examples of disassembly processes are the "disassembly" of animals in the meat industry (Duvall and Hoffman, 1983), or the disassembly of used cars or copiers. Note that disassembly activities will become still more and more important in the nearby future due to an increase in the recycling of materials resulting from a growing scarcity of all kinds of materials.
An example of a process where ni=no concerns the drying of clothes or painted subjects in the open air.

"Deterministic" versus "stochastic" processes.

Upto here it was more or less implicitly assumed that the set of outputs resulting from the execution of a process is completely predetermined, both from a quantitative and a qualitative point of view.
Theoretically the result of the execution of every process is more or less uncertain. In this paper the execution of a process is called "stochastic" if it is not possible to forecast its results "within certain given boundaries" solely due to the characteristics of the process itself.
(There are all kinds of reasons why the execution of a given process may result in a set of outputs different from the one than has been planned. Varying results may occur due to the "quality" of the work instructions or input materials, the state of the hard ware or the operator(s), the values of the process parameters or the way the process is executed. Examples can be found in the processing of crystal wavers in the semi-conductor industry, or in the refinement of oil. All these reasons are not related to the characteristics of the process itself however.)
In all other cases the execution of a process is called "deterministic".
Examples of "stochastic" processes are met in the production of semi-conductors, like in the processing of crystal wavers, see for instance (Campbell, 1988), whereas the drying of painted subjects or clothes are examples of a "deterministic" process.

Flow wise versus intermittent processing.

The last aspect of individual processes (operations) that is considered in this paper concerns whether or not some or all of the resources involved in the execution have to be set up anew, partly or completely, for the processing of each individual copy of a product, for each product, or for groups of products.
A process is executed "flow wise" if no set up of the resources is required. In all other cases a process is executed "intermittently".

Inter process relations.

Upto here we considered the aspects of the individual operations (processes) that together make up the complete set of operations that have to be executed for the production of a given product or group of products in relation to the planning, release and progress control of work. Clearly the latter three activities will also be influenced by the mutual relationships between the different operations.
Notably it matters how the different operations (processes) are coupled. For instance the outputs of one operation may become "automatically" and "immediately" inputs for other operations due to the production facilities (hard ware) used". This applies for instance

or an assembly line, where a number of production units (work stations) are physically oupled with eachother. The line as a whole produces/processes products with a certain ate when the line as a whole has a given setup.
t may also be that a given process for a given product has to be executed within a given eriod of time after the foregoing process was finished, or can only be executed after a ertain time.

nalogeously to the definitions "flow wise" and "intermittent" with respect to the xecution of a single process, "flow wise" and "intermittent" can also be defined with espect to the execution of a number of consequtive processes. As far as the producti-n/processing of one single copy or number of copies of a given product is concerned a umber of processes are executed "flow wise" if after the execution of a process the copy copies) is (are) directly combined with the remaining inputs for the next process so that he latter process can be executed immediately.
wo consequtive processes are executed "intermittently" if some time elapses in between he execution of these processes.

ummarizing the above we arrive at the following aspects related to the execution of a group of) process(es) which may be expected to play important roles in the definition of roduction orders

rom an input point of view:

. Multi-product versus single-product processing

rom a processing point of view:

. Simultaneous versus sequential processing
. Multi-product versus single-product processing
. Assembly versus disassembly
. "Flow-wise" versus "intermittent" processing.

rom an output point of view:

. Multi-product versus single-product production
. "Deterministic" versus "stochastic"

esides the relationships between the processes play an important role.

erewith ends our overview of characteristics of processes that may be expected to play an mportant role in how work is planned, released and its progress is controlled.
n the next section of this paper we shall give an overview of presently used production rders and their relations with the above mentioned aspects of production processes.

RODUCTION ORDERS

roduction activities are triggered and their progress is controlled via production rders. Via production orders non-material resources and materials are linked together. By efining production orders we do not only influence the flow of materials through our ompany but also the efficient usage of resources. The sizes of production orders play an mportant role with respect to our production flexibility.

n general production orders fulfill a number of functions. They are used as
a unit for the time-phased planning of resources
a "vehicle" for registering/controlling the progress of work
a "vehicle" for registering the usage of resources

-a document containing operation instructions
-a document for registering quality information
-a document for lot traceablity.

With respect to production orders the following aspects have to be considered
A. Their definition
B. Their release to a production unit
C. The control of their progress
D. Their (partial) receipt.

In this paper attention will be focussed on their definition.

Material based production orders versus processing facility based production orders.

Although always all required resources have to be taken into account in order to define and realise production plans, production activities may be triggered starting from either the set of materials required or from the set of available processing facilities. One often distinguishes between so called "material" and "capacity" ("process") oriented production situations.
These two orientations often result from the relative contributions of the materials and "non-material" resources to the production expenses of a company, and the time required for obtaining these two resources.
Examples of "material" oriented production situations can be found in the production of meat, processing of milk, whereas the production of glass provides an example of a "capacity" oriented production situation.
Related to the above sub division one also distinguish between material based or "capacity" based control systems, leading to the usage of material or "capacity" based production orders.

Input driven versus output driven production orders.

Often production orders state how many copies of a given product have to be produced by means of a given set of input resources within a given period of time. Essentially these orders are directly related to the timely delivery of predescribed quantities of predescribed outputs (output materials).
In accordance with the above is the definition of a production order given in the APICS Dictionary (APICS, 1991)
"A document, group of documents, or schedule identity conveying authority for the manufacture of specified parts or products in specified quantities".

In many production situations production orders like "Process this complete roll of paper" (paper industry), "Process this crystal wafer" (semi-conductor industry), "Execute this process till the bath with fluid X is completely empty" (painting unit), "Process all the requests in this bag" (post office, insurance company) are used. All these orders are stated in terms of (how) one or a number of the (material) inputs are supplied to one or a series of processes.
(In the first three examples in terms of one of the input materials, in the latter example in terms of the transport medium used.)
Although the above input driven orders may coincide with the usual output driven orders if the amount of materials supplied is just enough to produce the required quantities of outputs, the set of outputs is often less well stated in advance in terms of quantities or qualities than when output driven production orders would have been used. In principle the latter define the moment that an operation is finished in terms of quantities of outputs, whereas input driven production orders state this in terms of being used up of a material, or an empty container.
(Alternatively one might state that input driven production orders are primarily used for

tarting the execution of processes, whereas output driven production orders are primarily sed for ending the execution of processes.)

he following classifications of production orders met in practice are based on the ifferent aspects of production processes dealt with in the foregoing section of this aper.

ingle-product production orders versus multi-product production orders.

n many production environments production orders are defined for one or aa number of opies of one single products only. Thereby often demands from several internal and xternal customers for a given product (article code) are combined. Examples are producti-n orders for the production of a given television set or for the simultaneous production f a number of copies of a given cookie.
here are also a lot of production situations where production orders are defined for the simultaneous) production/processing of one or a number of copies of a number of different roducts, which applies for instance to the (simultaneous) production of a number of ifferent cardboard boxes or blister cards.
n the following the latter orders will be denoted by multi-product production orders, hereas the production orders mentioned before will be called single-product production rders. Essentially a multi-product production order denotes a bundle of single-product roduction orders which are triggered and controlled together. Like single-product roduction orders, multi-product production orders may be defined for individual operati-ns, a number of directly consequtive operations or all operations for a number of different) products.

n order to trigger the (simultaneous) production of a number of different products, or he (simultaneous) processing of a number of different materials or parts, both single-roduct production orders and multi-product production orders may be used.
easons for clustering single-product production orders may among others be
a combined usage of resources, which applies for instance to the production of co-products
a reduction of administrative activities
the characteristics of a customer order, which holds for instance for products that do have to have exactly the same color, or for wooden furniture that has to be made out of the same tree
internal transport efficiency, like the combined usage of pallets.

hich type of production order should be used is not as clear as it may look like at first ight. This holds especially if the production of given parts (products) involve both perations that have to be executed simultaneously for a number of these parts (products) nd operations that are not or can not be.
wo important disadvantages concerning the triggering and progress control of processes operations) simultaneously executed for a number of different products by means of (a set f) single-product production orders are the coordination of these production orders and he administrative work involved.
hen multi-product production orders are used, these disadvantages would at least partly e circumvented for these processes.

n (Kimball, 1987) some attention is paid to the logistic and informational consequences f using multi-product production orders ("gang orders") for triggering and controlling he progress of the simultaneous production of products or the simultaneous processing of aterials, parts.
n (Wight and Landvater, 1983) some attention is paid to the special provisions in ogistic control information systems that are required to deal with the types of orders escribed in (Campbell, 1988) and (Duvall and Hoffman, 1983).

A systematic study concerning the logistic and informational aspects of using multi-product production orders as well as an overview of the pro's and con's of these orders when compared with the usage of single-product production orders for the production of card board boxes and blistercards is presented in (Flapper, 1992). In (Flapper, 1992) also attention is paid to the consequences of "simultaneously" using single and multi-product production orders for different groups of operations that have to be executed within the context of the production of a given mix and volume of products within a certain period of time.

Production orders for assembly versus production orders for disassembly processes.

Often separate production orders are defined for the production, or procurement, of the different parts that are assembled and for the different operations starting from the assembly process. Usually production orders are based upon this "chain wise" decomposition of networks of activities.

The standard way to cope with disassembly processes from an informational point of view is to use a divergent (inverted) bill of material structure and single-product production orders indicating the production of one of the desired outputs ("target output"), whereas the produced quantities of all the other outputs are based on the quantity produced of the target output.
See e.g. (Mather, 1987) and (Wight and Landvater, 1983).
Clearly the above approach is only useful if there exist fixed relationships between the quantity produced of the target output and all the other outputs. For more comments on the above approach see the above two references.

An alternative approach is presented in (Duncan, 1983) where the so called "By-Product Bill of Material" is introduced. The approach starts from the processes, and takes into account "all" inputs into and "all" outputs resulting from the execution of each of these processes.

An approach that avoids part of the problems related to the above two approaches may be to look upon a disassembly process as a simultaneous production of the products resulting from this process and use multi-product production orders for the triggering and progress control of this process.

Production orders for "deterministic" versus "stochastic" processes.

The usual single-product MRP production orders are examples of orders used for products which routings involve only "deterministic" processes.
Examples of production orders taking into account "stochastic" processes are among others described in (Campbell, 1988) and (Wight and Landvater, 1983).
The latter orders have much in common with the production orders used for disassembly dealt with above.

Production orders for flow wise versus intermittent processing.

This aspect is not taken into account via special types of production orders but via the size of the latter and the decision to use either single- or multi-product production orders.

Considering the above sub sections, we conclude that there are essentially eight different types of production orders. These types are given hereafter, together with one or more examples of applications in between brackets.

1. Sequentially, single-product, output driven (bicycles)

. Sequentially, single-product, input driven (insurance, post)
. Sequentially, multi-product, output driven (mixed model, multi model)
. Sequentially, multi-product, input driven (Group Technology cell).
. Simultaneous, single-product, output driven (cookies on a belt)
. Simultaneous, single-product, input driven (sawing of a tree)
. Simultaneous, multi-product, output driven (blister cards)
. Simultaneous, multi-product, input driven (paper rolls, crystal wavers, crude oil)

roduction orders for one or a number of operations.

hether a production order is defined for one or a number of operations depends strongly n how these operations are related. As mentioned in the foregoing section of this paper t may be that (operations) processes are physically hard coupled due to the hardware nvolved in the execution of these processes. Other often used arguments for deciding on he operations handled via one production order are the physical position of the resources sed for the execution of the different operations, the organisational structure of the roduction network, the amount of administrative work and, very important, the simplicity f logistical control and the loss of flexibility.
ithin the context of this paper this topic will not be discussed any further.
or a systematic discussion on this point with respect to the production of cardboard oxes and blistercards see (Flapper, 1992).

erewith ends our overview of presently used production orders, some of their most mportant logistical characteristics and some of their specific information requirements, s well as examples of production situations in which they are presently used.
n the next section we shall consider production runs.

RODUCTION RUNS

here are a lot of situations where the production of a number of different products equires partly the same set of processes to be executed, using the same set of resources, ike materials and machines, even requiring the same, or almost the same values of all rocess parameters, i.e. setup.

t may be that the time required for setting up one of the resources is considerable and hat it is very important to avoid as much as possible setting up the resources anew. This pplies especially to so called bottleneck resources.
here are also a lot of production situations where due to the production method and esources used, or based on financial arguments, minimum amounts of certain materials have o be processed in one go. Also in that case the coordination of the production of ifferent products is very important.

ia production runs the intended or actual usage of a "dominant" resource, or group of esources, during given periods of time is indicated (planned).
hereby the "dominant" resource may be one machine or group of machine(s), like a complete ssembly line, requiring a lot of time to be setup anew; one or a group of operators that an only be available during certain periods of time, which holds for instance for urgeons; a material, or combinations of these resources.

roduction runs, in contradistinction to production orders, are only used as units for the ime-phased planning of resources.
ne can distinguish between production runs at goods flow control (GFC) level, used for ndicating production cycles, and production runs at shop floor control (SFC) level.

GFC PRODUCTION RUNS.

LOGISTICAL ASPECTS.

As discussed above, it may be useful to reserve (plan) resources at GFC level for processing certain groups of products during certain periods of time or reserve resources for executing a given group of processes using a given range of process parameter values, a considerable time before the actual processing will take place.

In this way it may be possible to change process parameters more smoothly, such that the total set up time and scrap quantities for a given work package are reduced to a minimum. This applies for instance to the production of sheets of paper or steel when machines are used, taking a lot of time to be setup anew, where the setup times depend on the width, quality and weight of the sheets to be processed. By changing the width smoothly from for instance 10 upto 180 mm. a lot of time may be saved.
Another wellknown example concerns a painting unit where one starts with products that have to be painted white and ends with products that have to be painted black.

Apart from the above GFC production runs based upon the processing facility used, also purely input material driven GFC production runs can be met in practice, which holds for instance with respect to the production of meat, where during one day a week only pigs are dealt with, another day cows etc.

Examples of GFC production runs based upon the combination of materials and processing facilities can be found in the production or processing of paper or steel.

Often a GFC production run is planned in advance without knowing the actual customer or production orders that will make up the run. To which specific products and customer orders the "dominant" resource(s) will be allocated is often estimated later.
GFC production runs are actualised via one or a number of single-product and multi-product production orders.
From the above it will be clear that GFC production runs will be often used in production situations using cyclic production schemes.

The usage of GFC production runs has among others consequences for
-the lead times used for planning production and
-the delivery times to be given to customers.

In what respects differ GFC production runs from multi-product production orders at GFC level? What are the (dis)advantages of using GFC production runs over using multi-product production orders at GFC level?

Using multi-product production orders at GFC level makes sense if the combination of products to be produced together are predescribed for instance due to the usage of specific, relatively expensive, common tools or materials, which production takes a lot of time. This applies amongst others to the simultaneous production of certain groups of cardboard boxes and blistercards requiring common cutting frames.
In case the products are to be produced one after another, and there are no common materials, it may be better to use GFC production runs because the latter allow a more flexible use.

INFORMATIONAL REQUIREMENTS.

Considering the above, it will be clear that at least the following attributes for a GFC production run have to be defined

"Dominant" resource (*)
Set up dominant resource (*)
Product (*)
Reserved capacity (*) in terms of days, shifts, hours

here the * denotes that there may be more than one resource, product etc. involved.

e shall return to this topic in more detail later.

FC PRODUCTION RUNS.

OGISTICAL ASPECTS.

FC production runs, like GFC production runs, are used as units for the time-phased lanning of resources.

ften SFC runs are introduced for reducing the total time required for setting up one or a roup of consequtive processing facilities for a group of production orders. This makes ense whenever the set up time of one or a number of consequtive processing facilities nvolved is "considerable" and the reduction of the set up time may result in reduced xpenses, increased income or "increased flexibility".
n SFC production run consists of a number of single- and/or multi-product production rders that should be planned (scheduled) to be dealt with one after another (sequentialy), or simultaneously, by a given (group of) resource(s) in order to reduce set up, nd/or processing time.
n example concerns an oven, used for the (simultaneous) baking of a number of different otteries or heat treatment of a number of different metal parts, which set up or cleaning rom for instance damaging gasses takes a lot of time.

he "dominant" resource may as well be a material however, which holds for instance with espect to the paint to be used for painting sets of furniture, like a table with four hairs, when each component must have exactly the same colour, or to a piece of leather rom which both pairs of shoes as well as bags have to be produced in order to guarantee hat all these articles will show exactly the same texture.
nother example concerns SFC production runs based upon the quality of an expensive fluid n a bath, when the fluid keeps the required quality during a limited period of time only.
till other examples of input material(s) driven SFC production runs can among others be ound in the processing of complete rolls of paper where a complete roll "has to" be rocessed as a whole by a cutting machine, or in the processing of crystal wavers for roducing semi-conductors, as is described in e.g. (Campbell, 1988).
he same applies to the production of different mineral waters, using the same water but dding different flavor components during one run.

he time scale involved in composing SFC runs may vary from a shift to a week or more.
hich orders are actually processed is determined by the timely availability of these rders at the work station at the shop floor. For this reason the actual length of an SFC roduction run does not have to be the same as the lenght of the planned SFC production un.
o an SFC production run is characterised by
a (set of) resource(s) and their eventual set up(s)!!!
one or a number of production orders.
he units to be dealt with by shop floor control are the individual single- and multiroduct production orders that are planned to be dealt with via the SFC production run.

rom the above it is already a little bit clear in what respects SFC production runs iffer from multi-product production orders at SFC level as well as what the (dis)advantages of using SFC production runs over using multi-product production orders at SFC level are.

SFC production runs differ from multi-product production orders in that they only indicate an intention (a plan). The actual composition of an SFC run can easily be changed upto the moment of actual processing. Whenever one or more of the production orders planned to be processed together is missing at the moment one starts working on a given SFC production run, this does not have any consequences for the individual production orders that were timely available to be processed. The individual orders can be processed (and released) individually.
When one of the components required for executing a multi-product production order is not timely available, all individual orders making up this order may be delayed. Often it is not then possible to replace the planned multi-production production order by the single-product production orders from which it has been made up for instance because some of the material requirements have been based upon the order as a whole which may differ from the total material requirements for the production of each of the different products individually and may require these orders to be processed together in one go.
Apart from the above kinds of technical problems, it would require all kinds of administration activities that may take too much time to allow a break down of a multi-product production order into all its underlying single-level production orders. In all these cases SFC runs are to be preferred over multi-product production orders.
(SFC production runs may be looked upon as flexible multi-product production orders.)

As with production orders, SFC production runs may be defined for one, a number of consequtive, or all operations making up part or whole of the production routing of a number of production orders.
Defining SFC production runs for one single or a number of consequtive operations makes sense if the production routings of a number of different products only coincide with respect to these operations, whereas the remaining sets of (ordered) operations differ with respect to the types of processes involved or the sets of resources that are available for the execution of these processes. In these cases the introduction of production orders to take advantage of common (set ups) of production facilities and common materials would at least require the introduction of separate production orders for the operations that have to be executed before the common operations, the common operations as well as the set of operations following the common operations.

In case the execution of two production orders requires exactly the same resource requirements, having the same setups, for the same times, both SFC production runs and multi-product production runs may be used.
However if there exists a considerable uncertainty with respect to the timely availability of one or several materials, and the material requirements are based upon the individual production orders, it may be better to use single-product production orders together with SFC production runs instead of a multi-product production order.

Summarising, SFC production runs may be worth to be considered in production situations where the processing/production of a lot of products require for one or a few consequtive operations out of their complete set of operations the same set up of a number of resources and the same processing time.

INFORMATIONAL ASPECTS.

In order to derive the necessary attributes of GFC and SFC production runs, the hierachical relations between the different types of production orders and the different types of production runs are indicated in Fig.1.

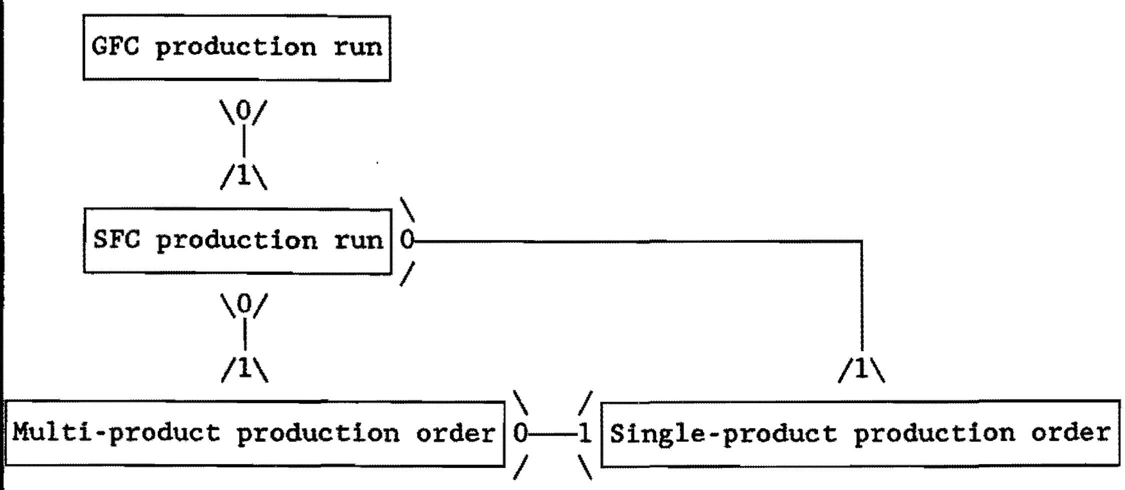

FIGURE 1 : THE HIERARCHICAL RELATIONS BETWEEN PRODUCTION RUNS AND PRODUCTION ORDERS

As depicted in Fig.1, and mentioned before, one GFC production run may consist of one or a number of SFC production runs, as holds respectively for the production of glass and the baking of pottery, if the same set up of an oven is required but different baking times. Clearly a given SFC production run does not need to be related to one or a number of GFC production runs, as holds amongst others for the printing of cardboard boxes and blister cards. An example of a production situation where one SFC production run belongs to a number of GFC production runs is given by pottery that has to be painted and baked.
A given SFC production run may consist of one or a number of multi- and/or single-product production orders, as applies e.g. with respect to the production of cardboard boxes and blistercards.
Clearly a given multi- or single-product production order does not have to make up part of an SFC production run.

Attributes SFC production run.

-Resource (*)
-Setup resource (*)
-Production orders (*)
-Input materials (*).

SUMMARY AND CONCLUSIONS

In this paper an overview of presently used production orders and production runs was given. Thereby attention was paid to the logistical and informational consequences of using the different types of orders and runs. It was discussed under which circumstances each of these orders and runs may be profitable and when not.
By considering both production orders and production runs a more or less complete overview of the different quantities used for defining the timely planning of work was presented. The authors hope that this paper will stimulate managers to consider anew the types of production orders and runs to be used in their production units.

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