

The Complete Kit Concept – Implementation in the health care system

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One of the fundamentals of good health care management that is rarely discussed in the literature is the 'complete kit' concept, which suggests that operations, medical procedures and processes should not start until all the items required for completion of the job are available. These items (the kit) include medical documents, medical tools, information etc. Starting a medical procedure with an incomplete kit means more medical time to finish the procedure, longer lead time, more 'work in process', reduction of throughput, poor quality and impairment of due date performance. This paper analyzes the various facets of the complete kit concept in the health care system and suggests how to implement the complete kit concept in a medical process. The paper also incorporates the complete kit concept into the context of well-established managerial philosophies such as TOC and TQM.



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1. Introduction

For more than 20 years the health care systems of most western countries have been faced with the challenge of dealing with massive increases in health cost in real terms and as a percentage of GNP. As a result, they have been obliged to cut expenses in other sectors in order to provide their people with a reasonable health care system. Classical breakdowns of health care system costs can be shown in either the supply part or in the demand part. In this paper we present and illustrate a managerial philosophy which can be applied to a health care system in order to provide a better system without an increase in expenditures.

The Complete Kit (CK) methodology and its theoretical background are easy to understand and not dif-

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difficult to implement. This managerial tool has been implemented in various organizations with a high success rate. It is easy to adopt in every environment and situation, providing much benefit in relatively short time spans. We present here the concept of a CK and show how it can be implemented in the health care system by demonstrating its high accomplishment rate in several medical processes in environments such as emergency rooms and operating rooms. Working with a CK leads to fastest productivity gains. Based on our experience, it is surprising that little has been done in the medical field utilizing this method as an effective means to improve quality and better medical services. Taking into consideration the CK's simplicity and effectiveness, it is somehow surprising that Just-In-Time (JIT) adherents like Schonberger [11] and Suzaki [13] pay such little attention to it. Proponents of Total Quality Management (TQM) [3] relate to it only implicitly by saying 'do it right the first time and on time'. The Theory Of Constraints (TOC) does not address the phenomenon at all.

The CK methodology is easy to adopt in the health care environment and provides much benefit in a relatively short period of time, as in other industries today [1,4,6,8].

This paper analyzes the complete kit concept and its implications for better health care management.

2. What is a complete kit?

A complete kit in health care is the set of components, medical documents, medical materials and information, imaging laboratory results and other information needed to complete a given procedure, medical process or task. A complete kit is the readiness of the kit prior to initializing of the procedure.

There are two types of kits. The Inkit is the kit required as an input to the operation or medical procedure. The Outkit of a given task is the kit required as an output of the operation or medical procedure. The Outkit of a given operation may be the Inkit of the next stage.

2.1. The evils of an incomplete kit

Understanding the evils of working with an incomplete kit is very important. We use three examples from the health care environment: the emergency room, the operating room and pharmaceutical purchase.

2.1.1. More work-in-process (WIP)

Any specific task in a medical environment defines a process. For the emergency room example, the process includes among other things: taking the medical history of the patient, nurse and physician examinations, medical tests and conclusion reached by the physician to release the patient to the health care community or to hospitalize the patient. Work-in-process (WIP) in the emergency room means, for example, people waiting for completion of the admission process. Using an incomplete kit causes more WIP, i.e., more people waiting in the emergency room, because the job is invariably waiting for additional components to arrive. For example, if a specialist consultant is requested for a patient in the emergency room and starts the examination without having a complete kit (i.e., all lab results, imaging results and ECG), the specialist may need another visit once the results are available. This causes more waiting time for the patient, while the consulting physician is not always available and may be considered a bottleneck. Of course, in cases of extreme emergency and danger to the patient, one can define an immediate kit of information for the given situation.

2.1.2. Longer lead-time (LT)

Lead-time (LT) is the time from the starting point of the process to its end. In the operating room the lead-time would be the time from when the patient is moved to the operating room until he is moved back to the department or to the intensive care unit. The linear (proportional) relationship between the level of WIP and the 'production' LT has been widely discussed [11]; more incomplete kits cause more WIP and hence longer lead-time. Since lead-time is considered to be a source of tactical and strategic advantage to an organization, it is extremely important to use all possible methods to reduce it to a minimum. In the operating room, a patient arrives without a CK (e.g., he doesn't have his electrolytes results). The anesthetist may decide to wait until the patient has taken the test and receives the results, or he may postpone the surgery. In any case, this causes longer lead-time.

2.1.3. High variance of quoted and planned lead-times

It is very difficult to quote a lead-time when a major piece of information is missing and difficult to guess, e.g., predicting when a missing item will arrive. Longer lead-time means difficulties in planning and scheduling, which results in inefficient performance of the operating room. If a patient arrives with a CK for a routine procedure or test (colonoscopy for example), it is

quite easy to predict the procedure lead-time; the lead-time deviation is considered relatively small. However, if a patient arrives with an incomplete kit, the lead-time variance increases, and causes difficulties in prediction, scheduling and planning, which results in inefficient performance and poor quality of services.

2.1.4. *Poor quality and more rework*

Much work-in-process causes poor quality performance, both in terms of level of service to the patient and in the delivery of clinical quality. Patients arriving with incomplete kits tend to wait in inadequate facilities for too long. When the missing items or information arrive, they are seen by the doctors for the second or third time. This undoubtedly leads to poor quality service. The clinical outcome may also be impaired and the fact that a patient coming with an incomplete kit is double and even triple handled, sometimes by another doctor or another shift team, causes a severe decline in quality.

2.1.5. *Decline in throughput*

The number of patients being operated on in a specific time interval is the throughput of the operating room. Using an incomplete kit in the operating room results in decline in throughput.

2.1.6. *Decline in productivity*

Using an incomplete kit increases both setup times (i.e., setting the operating room for the next patient) and the required time per patient, taking into consideration the double and triple handling. In a paperwork environment, such as that connected with the logistics of purchasing medication for the health organization, the inefficiency factor for using an incomplete kit is assessed to be approximately 80% [8]. This means that in the medical logistics systems, a process that takes 1.0 manhour using a CK, may be increased to 1.8 man-hour, should the materials (e.g., purchase order) arrive as an incomplete kit.

2.1.7. *More operating expenses*

High WIP causes more operating expenses on account of more holding costs, more scrap and more work put into the job. As noted by Schonberger [10], any operation that does not add value to the process is a waste. Poor quality costs more money, since more work must be performed [3]. Double setups add more expenses to the process.

2.1.8. *Decline in staff's motivation*

Using an incomplete kit goes against the grain. It diminishes their motivation and trust in the system when staff members are forced to do more and apparently un-

necessary work. A prime example is that of a physician on duty in the emergency room needing to see many patients unnecessarily three or more times because an incomplete kit is being used.

2.1.9. *Increase in complexity and control*

If one works using an incomplete kit, controlling the system becomes very complex, and sometimes almost impossible.

2.1.10. *Less effort to ensure arrival of the missing kit item*

Releasing an incomplete kit gives the illusion that every effort is being made to get the job done.

2.2. *What stops people from using a CK?*

If the benefits of using a CK are so obvious, why is it not used all the time? The answer seems to center around certain obstacles on the way to using a CK.

2.2.1. *Efficiency syndrome*

The efficiency syndrome is the urge to have resources utilized as much as possible. Following the fallacious notion that staff should be busy all the time causes managers to have their people working on incomplete kits just so that they should not be idle. More importantly, it also means more WIP, less throughput and more operating expenses [5,9].

The basic remedy for the efficiency syndrome is a major change in the management of the organization, such as introducing Total Quality Management (TQM) [3], the Theory Of Constraints (TOC) or Just-In-Time (JIT) [11,13], incorporating CK into this overall implementation. Indeed, a CK practice works best as part of a total management philosophy.

The efficiency syndrome is counterproductive if the operation has either an internal constraint (bottleneck resources) or an excess capacity. In the bottleneck environment, there are always other jobs that can turn into immediate throughput. In cases of excess capacity, there is more pressure to use an incomplete kit, just to utilize resources. There is no justification whatsoever for this, since excess capacity means shorter lead-time; thus there is virtually no advantage to starting work in an incomplete kit mode.

2.2.2. *Pressure for immediate response*

It is well known that the process time is only a small part of the total lead-time. For example, the median lead-time in a large emergency room is about 4 hours, while the 'process time' is only about 25 minutes. Sometimes the physician starts treating a patient

with an incomplete kit because of system pressure for immediate results, though he knows he will not be able to finish the procedure without it.

2.2.3. *Anxiety to show goodwill on the part of the staff*

As a result of management pressure, laboratory technicians, nurses and even physicians express their goodwill by releasing incomplete kits to the floor.

3. The CK in the health care system

In a paperwork environment such as that characterizing medical logistics, the rule is to start working only if the kit is complete. For example, in the purchasing of pharmaceuticals the process will not start unless the kit includes all the documents and information needed (i.e., end-user approval, budget number, etc.). In such an environment a gatekeeper is designated as the only person authorized to release jobs. Clearly you cannot finish the work if you are missing a document or a form. The main point is not to start until all the documents are at hand.

We next demonstrate using the CK paradigm in a colonoscopy performed in a gastroenterology department. Colonoscopy is one of the most significant diagnostic and therapeutic applications of endoscopy, because it can diagnose potentially curable colonic cancers that would be missed by other techniques, and it can be used for the removal of potentially precancerous adenomatous polyps. Most initial colonoscopies are performed to investigate findings on an abnormal barium enema or to elucidate the cause of gastrointestinal bleeding. The ability to examine the whole colon is also useful in the management of some patients with inflammatory bowel disease and in patients with a strong family history of colonic polyps or cancer. The CK of a colonoscopy includes various medical facilities that are needed for the procedure, such as the endoscope, various medications, a resuscitation cart in a state to give a solution to any medical life support situation, etc. One important procedure before initializing a colonoscopy is the preparation of the patient with laxatives and tap water enemas or by a total-gut lavage with a nonabsorbable electrolyte solution. At least 24 hours are needed to achieve good preparation. If a patient now cancels his colonoscopy scheduled for the next day, another patient on the list is invited instead. The new patient arrives at the clinic unprepared, and the result in many cases is an incomplete examination and the need for a second colonoscopy. The dam-

age is two-fold: there is waste of medical facilities and the patient does not receive good health care services. Moreover, the results of the colonoscopy may be inconclusive and there may be a misdiagnosis. Had the gastroenterology department worked with a complete kit, situations like these would be rare. Therefore, it is important to instruct the staff not to invite a patient for colonoscopy without full preparation. It is preferable to absorb the waste of time and resources due to cancellation rather than to enter a procedure without a complete kit. One can use other methods to improve the operation of the department. For example if the cancellation rate is 10%, one should invite for colonoscopy 10% above the capacity of the department, and then three days before the scheduled date call every one to confirm their arrival. Using the CK methodology will increase the production and the clinical quality of the department by at least 30%.

As we show in the next subsections, implementation of the CK concept in a health care environment is well supported by modern management philosophies and techniques such as TOC, TQM and JIT.

3.1. *TOC (Theory of Constraints) support*

According to the TOC [5,9] the goal of a health care organization is to provide good quality medical services in the present as well as in the future. Using the complete kit paradigm will increase the number of patients receiving medical treatment, their satisfaction and the quality of the treatment. In the TOC terminology, working with an incomplete kit is considered a 'policy constraint' and should therefore be eliminated.

3.2. *TQM (Total Quality Management) support*

An organization that works according to TQM principles will soon come around to adopting the CK concept. Along the route to improving processes, many negative effects (like high WIP, misdiagnosed patients, etc.) will be traced to the use of incomplete kits. TQM tools – control charts, the Pareto diagram and others – can maintain and monitor the CK process. The TQM control cycle will support avoidance of the incomplete kit. A control chart of the process lead-time will detect the exceptional batches. A cause and effect diagram will get at the root of the problem: an incomplete kit. A Pareto diagram can show the main contributors to the phenomenon (either classification by customers or classification by the missing items). Reduction of lead-time, monitored by the appropriate control chart, will show the improvement.

3.3. *Implementing the complete kit philosophy in the organization*

The following steps are suggested to implement a CK process.

- (1) The introduction of a CK process has to be part of a major change in the organization. It has to be part of a JIT, TQM or TOC implementation.
- (2) Top management has to be involved in the process. Without the support of top management there will be tremendous pressure from second-line managers to start processing incomplete kits, in the belief that this will speed up the work.
- (3) One person has to be appointed in each department to be in charge. Usually, it is the gatekeeper, that is, the person who releases the kits to the floor.
- (4) The process must be monitored: Pareto charts need to be drawn, classifying incomplete kits by types of treatments, types of patients, or by the missing components. Using cause and effect techniques (fishbone diagrams, effect-cause-effect, etc.) reasons are sought and corrective actions applied. The usual TQM way of improving processes may be employed here with good effect.
- (5) Employees and internal customers need to be informed of the change. Several organizations that have adopted the concept have designed special workshops to cope with this issue. The use of personal computer simulations and demonstrations using special software has been introduced into the educational process.
- (6) External customers (such as HMOs) should be notified that they will get better due date performance and better quoted lead-times if they submit a CK. For example, HMOs should be informed that the laboratories are using the complete kit methodology and hence will expect that all patients referred should arrive with a complete kit.
- (7) The term complete kit should be redefined from time to time according to the circumstances. A good rule is – work smart and beware of inertia.
- (8) Components and materials should be ordered in complete kits. Instead of ordering batches of the same components, the provider should order a kit from his supplier. This applies to both internal and external suppliers.

- (9) All activities should be synchronized, ensuring that the outfit of the current activity is the inkit of the next one.
- (10) Components and procedures need to be standardized whenever possible. The more standard items, the more likely it is that a CK will soon be available.

3.4. *Implications for health management information systems (MIS)*

The MIS department in the health care organization has to support activities with certain tools to enable a CK. Thus, a kit management procedure should be developed. In any activity the MIS department should supply the relevant documents and information to give a complete kit, and ensure that the activity does not proceed until the kit is complete.

Insofar as most of the items in a medical CK are medical information and data, the MIS plays a major role in reinforcing and implementing the CK paradigm and should be designed accordingly. Using an intranet (or other communication tools) the MIS can maintain the CK framework by using an automatic checklist and providing the user the missing items for the CK. In cases where the health care organization has a data warehouse it can deliver the information items needed automatically. An intranet system can also search for missing items. If some of the items in the CK are created outside the organization, 'smart agents' using the internet and other communication facilities can be used to automatically deliver missing items to the CK. Electronic Data Interchange (EDI), networked computing, internet, intranet, extranet and data warehouse (for example, [7]) can contribute to better completion of the kit. For example, a computer-aided system using the CK concept can reduce the time for FDA approval of a new drug. The CK application in this case would involve collecting many items automatically by scanning data into a computer, providing indexed data on line for quick retrieval, running an automatic check list, and, once the kit is complete, sending the data on a CD-ROM to the FDA.

Information systems that support the CK concept can be part of ERP or special purpose systems, like those described by Czuchry et al. [2].

3.5. *Implications for the medical purchasing and logistics department*

The purchasing department would be required to change its procedures according to the CK concept:

- (1) It would purchase CKs. The orders would be in kits rather than in components.
- (2) This would force the purchasing department to work with less suppliers and purchase more items from each supplier.
- (3) Suppliers would be evaluated not only by price, lead-time and quality, but also by the completeness of the kits.

4. Field results

A study of health care organizations as well as industrial organizations that have implemented the complete kit concept show that it has reduced WIP and cut lead-time by a factor of three. In one implementation in the health care system, using a complete kit together with small lots and drum-buffer-rope scheduling [12] as well as gating, led to a substantial increase (up to dozens of percentage points) of throughput.

Though it is too early to make any comprehensive assessment of the value of introducing the CK concept in health care organizations, preliminary results show a major improvement in the following areas of health care: emergency rooms, operating rooms, outpatient clinics, the radiology department.

5. Conclusion

The complete kit is a concept well-established, tried and trusted in manufacturing, with considerable potential for improving health care systems. It can be used to gain a strategic competitive edge because of the faster response times, lower prices and better quality that it yields.

Our experience shows that the health care system is an environment in which the complete kit concept can be applied with good effect. Experience in training and educating executives, managers, physicians, nurses and other paramedical staff shows that in many cases the practitioners need a formal framework, even

though their intuition about the CK is good. They need a theoretical background and methodological framework such as those presented in this paper to better cope with the pressure from bosses to start working with an incomplete kit. Today's medical staff does not have the administration backing to say no to an incomplete kit. The intention of this paper is to impress the management of health care settings to provide such backing.

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