Tentamen TEK685 - Produktionsutveckling (7,5 Hp)

Läsår: 2023/2024, lp2

Program:

TIEPL EKONOMI OCH PRODUKTIONSTEKNIK, HÖGSKOLEINGENJÖR, Årskurs 1 (obligatorisk)

TKTFY TEKNISK FYSIK, CIVILINGENJÖR, Årskurs 3 (obligatoriskt valbar)

Institution: Teknikens ekonomi och organisation

Datum och tid: **Fr 05 Apr 2024, 14:00, Lindholmen-salar INSP**

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Poänggränser – betyg: För betyg 3 krävs 20 poäng, för betyg 4 krävs 30 poäng, för betyg 5 krävs 40 poäng.

Tillåtna hjälpmedel: Typgodkänd miniräknare, svenskt-engelsk lexikon och engelsk-svenskt lexikon

Digital inlämning via Inspera. (Pappersinlämning är inte tillåtet. Scanning inte tillåtet.)

Examinator tillgänglig på telefon under hela tentamenstiden.

Information:

Resultatet meddelas via Ladok senast 15 arbetsdagar efter tentamensdagen. Tid och datum för visning av tentamen meddelas via Canvas.

För att erhålla full poäng på uppgiften skall lösningen vara välstrukturerad och beräkningsgången/tankegången vara lätt att följa. Vidare skall lösningen i tillämpliga fall förses med text och figurer, ekvationer skall motiveras och svar skall tydligt skrivas ut. Även delvis behandlade uppgifter poängbedöms. Uppgifterna skall besvaras på svenska eller engelska. Om du upplever att information saknas för att lösa någon uppgift/praktikfall går det bra att göra antaganden. Inför lämpliga beteckningar och anta vid behov siffervärde. Dessa antaganden ska vara rimliga och redovisas med motivering.

Det är inte tillåtet att referera till svar på tidigare uppgifter i tentamen. Läs frågorna noggrant. För varje fråga gäller att den skall besvaras med utgångspunkt från det material som behandlats i kursen.

Uppgift 1 TEK685 april 2024 (10p)
1.1 Betrakta följande två påståenden:

1.) Följande skulle i allmänhet inte betraktas som en transformationsprocess: En klippning hos frisören.

2.) Bilar på en manuell biltvätt (firman tvättar bilen och kan även erbjuda invändig städning) kommer ut från biltvätten med en genomsnittlig takt på 10 bilar/timme. Bilar anländer med en genomsnittlig takt på 10 bilar/timme. Finns det risk att det finns en väntekö vid ingången till biltvätt? Svar: ja.

För dessa påståenden gäller att

A. Både (1) och (2) är falska

B. (1) är falskt och (2) är sant

C. (1) är sant och (2) är falskt

D. Både (1) och (2) är sanna

Kommentar:
En klippning hos frisören är en transformationsprocess. Att vänta på att träffa läkaren på akuten är inte en transformationsprocess.

Car wash: Yes, because arrival and processing are both variable. Cars may arrive in a group at lunch times. Also, all cars do not spend equal time at or are processed by all work steps—e.g., wash service only, cleaning or full service with wax and undercarriage work.

1.2 Betrakta följande två påståenden:

1.) Although all operations processes are similar in that they all transform inputs, they do differ in a number of ways, four of which, known as the four Vs, are particularly important: The volume of their output, The variety of their output, The variation in the demand for their output, The degree of visibility that the creation of their output has for customers.

2.) Transforming resources are the resources that act upon the transformed resources, usually classified as facilities (the buildings, equipment and plant and process technology of the operation) and staff (the people who operate, maintain, plan and manage the operation).

För dessa påståenden gäller att

A. Både (1) och (2) är falska

B. (1) är falskt och (2) är sant

C. (1) är sant och (2) är falskt

D. Både (1) och (2) är sanna

1.3 Betrakta följande två påståenden:

1.) Flow efficiency is the sum of value-adding activities in relation to the throughput time.

2.) Resource efficiency is a measurement of how much a resource is utilized in relation to a specific time period.

För dessa påståenden gäller att

A. Både (1) och (2) är falska
B. (1) är falskt och (2) är sant
C. (1) är sant och (2) är falskt
D. Både (1) och (2) är sanna

1.4 Betrakta följande två påståenden:

1.) Följande påstående är sant om "Project Processes (Projektprocesser)": Unika, komplexa projekt, definierad start och slut, ofta lång livslängd, kräver koordinering mellan olika kompetenser.

2.) Den korrekta kombinationen av designbeslut (design decision) i en operation med låg volym och hög produktvariation (low volume, high variety operation) är: Standardisering av produkten är hög, generellt krävs högre kompetensnivåer, kontinuerligt flöde.

För dessa påståenden gäller att:

A. Både (1) och (2) är falska

B. (1) är falskt och (2) är sant

C. (1) är sant och (2) är falskt

D. Både (1) och (2) är sanna

Den korrekta kombinationen av designbeslut (design decision) i en operation med låg volym och hög produktvariation (low volume, high variety operation) är: Standardisering av produkten är låg, generellt krävs högre kompetensnivåer, flödet fortlöper med återkommande avbrott, oregelbundet (intermittent flöde)

1.5 Betrakta följande två påståenden:

1) Most practical layouts are derived from only four basic layout types. These are: Project processes, Jobbing processes, Batch processes and Mass processes.

2) In functional layout, similar transforming resources are located together.

För dessa påståenden gäller att:

A. Både (1) och (2) är falska

B. (1) är falskt och (2) är sant

C. (1) är sant och (2) är falskt

D. Både (1) och (2) är sanna

Kommentar:

Most practical layouts are derived from only four basic layout types. These are: Fixed-position layout, Functional layout, Cell layout and Line (sometimes called ‘product’) layout.

1.6 Betrakta följande två påståenden:

1.) Moving off the ‘natural diagonal’ of the product–process matrix will bring lower cost.

2.) The main process types in service operations are: Mass shops, batch services and jobbing services.

För dessa påståenden gäller att

A. Både (1) och (2) är falska

B. (1) är falskt och (2) är sant

C. (1) är sant och (2) är falskt

D. Både (1) och (2) är sanna

Kommentar: rätt svar är att Både (1) och (2) är falska. Moving off the ‘natural diagonal’ of the product–process matrix will incur excess cost. Se sid 191. The main process types in service operations are: mass services, service shops and professional services. Se sid 188-189.

1.7 Betrakta följande två påståenden:

1) En ökad grad av variation leder till en förbättrad prestationsförmåga hos produktionssystemet.

2) Ju större variation i processen är, desto kortare är genomloppstiden.

För dessa påståenden gäller att:

A. Både (1) och (2) är falska

B. (1) är falskt och (2) är sant

C. (1) är sant och (2) är falskt

D. Både (1) och (2) är sanna

En ökad grad av variation leder till en försämrad prestationsförmåga hos produktionssystemet

Ju större variation i processen är, desto längre är genomloppstiden

1.8 Betrakta följande två påståenden:

1.) När det gäller upplevd meningsfullhet/utmaning finner Hackman & Oldham starka kopplingar till tre faktorer: Kunskap, Växtbehovsstyrka och ”Omständigheter”.

2.) Enligt Hackman & Oldham har upplevt ansvar för resultatet en mycket tydlig koppling till uppgiftsidentitet.

För dessa påståenden gäller att

A. Både (1) och (2) är falska

B. (1) är falskt och (2) är sant

C. (1) är sant och (2) är falskt

D. Både (1) och (2) är sanna

Kommentar: rätt svar är att Både (1) och (2) är falska. När det gäller upplevd meningsfullhet/utmaning finner Hackman & Oldham starka kopplingar till tre faktorer: Uppgiftsvariation, Uppgiftsidentitet, Uppgiftens betydelse. Enligt Hackman & Oldham har upplevt ansvar för resultatet en mycket tydlig koppling till Autonomi. Se föreläsning samt s. 293 i kursboken.

1.9 Betrakta följande två påståenden:

1) Scientific management is a school of management theory dating from the early twentieth century; more analytical and systematic than 'scientific' as such, sometimes referred to as Taylorism, after Frederick Taylor who was influential in founding its principles.

2) There are five basic performance objectives which apply to all types of operation. They are: Quality, speed, dependability, flexibility and price

För dessa påståenden gäller att:

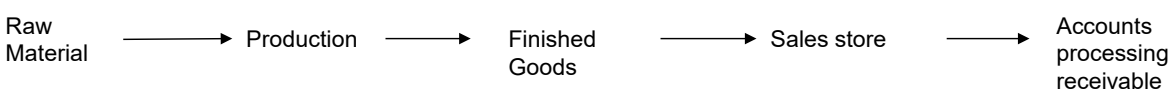
A. Både (1) och (2) är falska

B. (1) är falskt och (2) är sant

C. (1) är sant och (2) är falskt

D. Både (1) och (2) är sanna

1.10 A manufacturer of air conditioner compressors is concerned that too much money is tied up in its value chain. Average raw material inventory is $50 million. Sales are $20 million per week and finished-goods inventory averages $30 million. The average accounts receivable (kundfordringar) is $60 million. Production takes, on average, one week to produce a compressor and the typical sales through-put-time (or flow time) is two weeks. Assume 50 weeks in one year. The value chain is depicted below:



What is the total through-put-time (or flow time) of a throughput dollar?

A. 0,14 years, or 7 weeks

B. 0,15 years, or 7,5 weeks

C. 0,20 years, or 10 weeks

D. 0,25 years, or 12,5 weeks

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WIP = Throughput time (or Average flow time) *
Average Flow rate (or Average throughput rate)
R = Average throughput rate
T= Throughput time
(Numbers in italics are computed and numbers without are given in the case.)

WIP=R*T	Raw Material	Production	Finished Goods	Sale process	Accounts receivable Inventory
Inventory	$50m	***$20m (= 1 week * 20 m/week)***	$30m	***$40m***	$60m
Throughput rate	$1000m/yr or $ 20m/week	$1000m/yr or $ 20m/week	$1000m/yr or $ 20m/week	$1000m/yr or $ 20m/week	$1000m/yr or $ 20m/week
Throughput time	***0,05 y or 2,5 weeks (=50m /2 weeks)***	0,02 y or 1 week	***0,03 y or 1,5 weeks***	0,04 y or 2 weeks	***0,06 y or 3 weeks***

First, review the calculations in the table. If we add the flow times for each process in the value chain we obtain 0.05+0.02 + 0.03 + 0.04 + 0.06 = 0.20 years, or 10 weeks

Uppgift 2 TEK685 april 2024 (10p)
Uppgift 2.1. Describe briefly with your own example the typology of operations (the four Vs) that have been described in the course.

Skiss:

See Slack pp. 23-26

Although all operations processes are similar in that they all transform inputs, they do differ in a number of ways, four of which, known as the four Vs, are particularly important:

The volume of their output.

The variety of their output.

The variation in the demand for their output.

The degree of visibility that the creation of their output has for customers.

The importance of the Four Vs is that they are the result of strategic decisions that have been taken by an operation. The types of products and services it chooses to develop, and the type of markets that it chooses to enter, will define the volume, variety, variation and visibility with which the operation needs to cope. At the same time, all four Vs will affect the way that the operation's processes are managed.

The Four Vs act as a link between the strategic and operational aspects of operations management. The most obvious implication of an operation's positioning on the Four Vs is on processing costs. Put simply, high volume, low variety, low variation and low visibility all help to keep processing costs down. Conversely, low volume, high variety, high variation and high customer contact generally carry a type of cost penalty for the process. This is why the volume dimension is often drawn with its 'low' end at the left, unlike the other dimensions, to keep all the 'low-cost' implications on the right.

Uppgift 2.2. Running operations at an operational day-to-day level requires a tightly defined set of objectives. These are called operations 'five performance objectives'. Discuss briefly the five performance objectives of operations that have been described in the course.

Model answer:

- By 'doing things right' the operations function seeks to influence the quality of the organization's goods and services. Externally quality is an important aspect of customer satisfaction or dissatisfaction. Internally quality operations both reduce costs and increase dependability.
- By 'doing things fast' the operations function seeks to influence the speed with which goods and services are delivered. Externally speed is an important aspect of customer service. Internally speed both reduces inventories by decreasing internal throughput time and reduces risks by delaying the commitment of resources.
- By 'doing things on time' the operations function seeks to influence the dependability of the delivery of goods and services. Externally dependability is an important aspect of customer service. Internally dependability within operations increases operational reliability thus saving the time and money that would otherwise be taken up in solving reliability problems and also giving stability to the operation.
- By 'changing what they do' the operations function seeks to influence the flexibility with which the organization produces goods and services. Externally flexibility can:
    - produce new products and services (product/service flexibility)
    - produce a wide range or mix of products and services (mix flexibility)
    - produce different quantities or volumes of products and services (volume flexibility)
    - produce products and services at different times (delivery flexibility)

Internally flexibility can help speed up response times, save time wasted in changeovers and maintain dependability.

- By 'doing things cheaply' the operations function seeks to influence the cost of the organization's goods and services. Externally low costs allow organizations to reduce their price in order to gain higher volumes or alternatively increase their profitability on existing volume levels. Internally cost performance is helped by good performance in the other performance objectives.

The relative importance to an operation of performance objectives is influenced by the organization's specific customer groups and their needs, the activities of the organization's competitors, and the stage of its products and services in their life cycle. A particularly important concept here is the distinction between order-winning performance objectives and order-qualifying performance objectives.

Because operations strategy is always concerned with addressing customers' needs, at the operational level the focus is primarily on the five generic performance objectives of quality, speed, dependability, flexibility and cost. Each of these performance objectives has both internal and external effects. Externally their relative importance will differ depending on the nature of the markets served by the operation and/or its products and services. Internally, these objectives can be mutually dependent. One way of distinguishing between the relative importance of each performance objective is by classifying them as order-winners and qualifiers, and, more recently, as 'delights'.

Uppgift 2.3. Does the relative importance of performance objectives vary over time? Discuss briefly.

Yes, usually. Markets change, and the capabilities of operations resources develop over time. Therefore, not only does operations strategy change, the relative importance of its performance objectives will change. In fact, over the long term, the operations strategies of most enterprises can be seen to vary, either in response to deliberate attempts to change overall strategic direction or in a more emergent sense, where a consensus of the most appropriate strategic direction forms through accumulated operational experience.

Uppgift 2.4. Do operations performance objectives trade-off against each other? Discuss briefly.

Yes, and no. Yes, trade-offs are always, to some extent, inevitable in that pushing an operation to extremes in one aspect of performance will inevitably mean a sacrifice in other aspects of performance. Yet trade-offs can, at the margin, be overcome. In fact, the whole concept of operations performance improvement is, in effect, an attempt to overcome trade-offs. It is therefore the responsibility of all operations managers to seek ways of overcoming trade-offs. This also holds true when broader trade-offs are being considered, such as those between

corporate social responsibility (CSR) performance and more obviously commercial aspects of performance.

Uppgift 2.5. What are the advantages and disadvantages of focused operations? Discuss briefly.

The benefits of focus include achieving a clarity of performance objectives, which aids day-to-day decision-making, developing resources in a manner appropriate to achieve a narrow set of objectives, and the enhanced learning and improvement that derives from concentrating on a narrow set of tasks. On the other hand, the problems with focus include the dangers inherent if there are significant shifts in the marketplace, which may leave the operation 'stranded' with an inappropriate performance mix, the reduction in opportunities for economies of scale as operations are segmented internally, and some structural vulnerability because of the first two issues.

Uppgift 3 TEK685 april 2024 (10p)
What are the basic layout types used in operations and what is layout design trying to achieve?

There are four basic layout types: (a) fixed position layout, (b) Functional layout (or another name: process layout); (c) cell layout; and (d) Line (or use the term 'product') layout.

In addition to the conventional operations objectives which will be influenced by the layout design factors of importance include the length and clarity of customer material or information flow, inherent safety to staff and/or customers, staff comfort, accessibility to staff and customers, the ability to co-ordinate management decisions, the use of space and long-term flexibility.

Obviously this very much depends on the basic layout type chosen.

For fixed position layout, the materials or people being transformed do not move but the transforming resources move around them. Techniques such as resource location analysis can be used to minimise the costs and or inconvenience of flow of the transforming resources around the transformed resources.

In process layout all similar transforming resources are grouped together within the operation. The detailed design task is usually (though not always) to minimise the distance travelled by the transformed resources through the operation. Either manual or computer- based methods can be used to devise the detailed design.

In cell layout the resources needed for a particular class of product are grouped together in some way. The detailed design task is to group the products or customer types such that convenient cells can be designed around their needs. Techniques such as production flow analysis can be used to allocate products to cells.

In product layout the transforming resources are located in a sequence specifically for the convenience of product or product types. The detailed design of product layouts includes a number of decisions such as the cycle time to which the design must conform, the number of stages in the operation, the way tasks are allocated to the stages in the line, and the arrangement of the stages in the line. The cycle time of each part of the design together with the number of stages is a function of where the design lies on the 'long-thin' to 'short-fat' spectrum of

arrangements. This position affects costs, flexibility, robustness and staff attitude to work. The allocation of tasks to stages is called line balancing, which can be performed either manually or through computer-based algorithms.

Uppgift 4 TEK685 april 2024 (10p)

IceCo tillverkar och säljer glass. De senaste tio åren har företaget tillverkat ett begränsat sortiment i höga volymer, som säljs i familjeförpackningar till stora varuhus. Efterfrågan är stabil och företaget är lönsamt. Dottern till ägaren har nyligen utsetts till VD. Hennes plan är att företaget bör ändra strategin och diversifiera sitt produktsortiment för att reducera sårbarheten i att vara beroende av ett fåtal större kunder. Hon planerar att introducera en mängd olika specialvarianter av glass i mindre förpackningar (<=0,5 liter), som ska säljas till mindre kunder, som glasskiosker och mindre affärer.

Din uppgift är att skriva en kort rapport till den nye VD:n om effekterna av den föreslagna ändringen på produktionssystemet. Om du anser att du saknar information gör rimliga antaganden. Du ska kommentera på följande:

1) Skillnader i prestationsmål mellan de två typerna av kunder
2) Eventuella skillnader i efterfrågevariationen
3) Implikationer av förändringen för utformning och management av produktionssystemet

Skiss:

1. Använda polardiagram och peka på att för den första typen av glass och kunder är kostnad/pris och pålitlighet viktigare. Medan för den nya glassens kunder är flexibilitet, kvalitet och snabbhet viktigare. För full poäng är det att vikt att resonera varför dessa skillnader finns. De nya kunderna torde också vara mer trendkänsliga varför det är av vikt att vara flexibel i produktutvecklingen.

2. Eftersom de stora kunderna säljer glass året om och i större volymer så kommer förmodligen variationen i efterfrågan vara mindre för de större förpackningarna. Vad gäller de nya glassen kommer variationen förmodligen påverkas mer av väder och tillfälliga efterfrågeökningar. Dessutom torde de mindre kunderna ha mindre möjlighet att hålla lager varför snabbare och mer frekventa leveranser är viktigare.

3. Den tidigare produktionen torde vara fokuserad på stora batcher och låga kostnader medan den nya produktionen måste vara mer flexibel och anpassningsbar. Detta ställer krav på ny processteknologi, utvecklingsorganisation, kapacitet, förmodligen och att det kan behövas fler produktionslinor. Studenterna kan med fördel använda operations strategy matrisen för att illustrera skillnaderna mellan de olika typerna av glassproduktion.

Uppgift 5 TEK685 april 2024 (10p)

Children's Emergency Care Department, called Alfa, is the only emergency department for children in the region. The department has experienced issues with long waiting times for patients to receive care from a doctor. The patients at the department are children (up to 16

years old) who usually arrive together with parent(s) or relative(s).

Historically, problems with extended waiting times in the healthcare sector have been addressed through increased resources. However, that is not currently an option due to restrictions and stricter budget requirements. The department manager (Verksamhetschef) has enlisted a group of students from Chalmers to help explore potential improvements based on Operation Management principles. The manager wants to understand if an industrial approach might be useful, hence the hiring of engineers. The students have gathered the following information after a couple of days of observation at the clinic.

At the emergency care department, patients arrive either by walking, by car, or in an ambulance. A few patients arrive by the police or by helicopter. However, the department covers a large area, resulting in a high yearly inflow of patients. Each year, the department treats 47,000 patients, averaging 130 each day. 6% arrive in an ambulance. The mean throughput time is 3 hours, with 90% of the patients meeting a doctor within 5 hours (time to the first contact with a doctor).

The department treats all patients requiring emergency care. Undoubtedly, all receive care; however, the clinic might refer/send the patient to another caregiver better suited for specific requirements. The inflow of patients is unevenly distributed throughout the day, as shown in the figure:

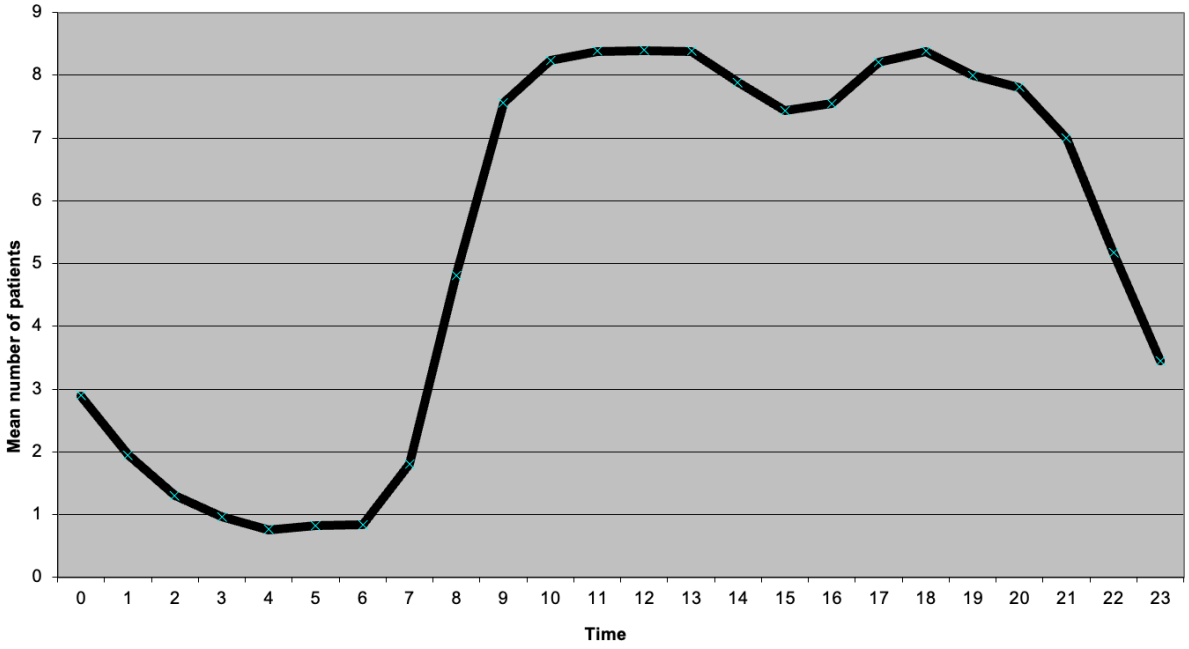

Figure 2: Average number of paGents per hour

The influx of patients to the clinic is largely influenced by parents' working hours. The majority of patients arrive during evenings and weekends, a consequence of parents' working hours as well as access to a car. Nevertheless, the most critical cases are distributed quite evenly throughout the day. It is worth noting that the total number of people in the clinic is quite high, as almost all patients arrive with at least one relative. This means that, in addition to patient care, communication with the relative is needed, demanding additional time in each process step.

Staffing

The Department Manager (Verksamhetschef) is an engineer and is responsible for the overall operation. The management team also consists of a Care Unit Manager (Vårdenehetschef), a Deputy Care Unit Manager (Biträdande Vårdenehetschef) and two Care Unit Chief Doctors (Vårdenehtsöverläkare). The Department Managers has the overall medical responsibility.

The staffing is based on a shift system, and on every shift the following staffing and responsibilities for nurse managers are deployed:

- One nurse dedicated to the surgery/orthopaedics flow
- One nurse dedicated to the medication flow

These nurse managers are in addition to participating in the patient treatment, responsible for coordinating the rest of the nurses and the medical resource for each flow. During the day, the nurse manager is supported by the Care Unit Manager or Deputy Care Unit Manager, who acts as the operational manager for both the surgery/orthopaedics and medicine flow.

The Department Manager focuses heavily on the patient flow in the department and is very task- oriented. The communication between the Department Manager and the Care Unit Manager is frequent, and they regularly have lunch together. The Department Manager tries to spend a lot of time on the floor, recurrently taking walks around the department to analyse the workflow. He frequently takes pauses during the walks talking with the personnel and listening to their experiences and opinions. The Department Manager tries to work and manage the department using stats. He also tries to engage the Unit Chief Doctors in the overall operation management as well as delegating parts of the budget responsibility. However, despite this effort, the Unit Chief Doctors' management responsibilities are still unclear. Nevertheless, they play a very important medical role within the department.

At the department, four doctors are permanently employed. They work 60 % with caregiving, and the remaining 40% is dedicated to research or work at other care units. This means that the four doctors cannot be seen as four full-time equivalents. Instead, they correspond to 2,4 full-time equivalents. In addition to these full-time doctors, the unit employs a lot of part-time doctors, originating from other departments at the hospital. Usually, young and inexperienced doctors are positioned in the children's emergency care department for a longer period. It is not uncommon for these doctors to stay a couple of months. Older and more experienced doctors usually have a more fragmented schedule and spend shorter periods at the department.

The part-time doctors who join the team for short periods are generally considered to lack motivation to improve the department as well as to lack responsibility for the performance of the department. Overall, the team at the department is experiencing a lack of group motivation, due to the inconsistency of doctors.

The staffing of doctors is as follows during the day:

- Four doctors 08-12
- Five doctors 13-16
- Four doctors 17-22
- Two doctors 22-08

The staffing of nurses is even during the day and evening. They are during these times 11 scheduled. Of these eleven, seven are nurses and four are assistant nurses (undersköterska). During the night they are seven. The nurses' schedule follows a 3-3 system, meaning that they work 3 days and have then 3 days off. Furthermore, all nurses are permanently

employed at the children's emergency care department. The nurses' work assignments are separated into different areas, and each nurse works in the same area during a shift. However, they are changing the area every shift, making sure that the nurses get variation in work assignments as well as making sure that all nurses have a broad knowledge base. The stations are:

- Head nurse (see responsibilities above)
- Nurse (medicine or surgeon/orthopaedic)
- Receptionist
- Telephone nurse

The telephone nurse answers calls from parents asking for healthcare information. This is a vital process since this station can, potentially, reduce the influx of patients to the unit if they do not need emergent care and instead can book an appointment at the health centre. Despite this, the student team has noticed that it is common for the telephone nurse to assist the rest of the team due to high load. During these times, the telephone gets unattended. This has also become identified as a reason for an even higher influx of patients.

Organisation

The emergency care department has the overall responsibility to provide swift and flexible care. The requirements from the hospital on the unit are considered to be tough, and the unit intends to act with maximal speed and flexibility due to the high variety of cases and the relatively high amount of critical and life-threatening cases. However, this also means that the cost aspect of managing the emergency care unit is less dominating compared to a unit with scheduled care.

The organisational structure of the department is strongly decentralised. This is in many cases positive as the general feeling of responsibility is high within the team. A requirement in emergencies is that the group can make quick and pivotal decisions without having to consult managers higher up in the organization. Hence, a self-managing cross-functional team, characterised by flexibility and speed, becomes a prerequisite. However, due to the high throughput of doctors at the department, collaboration between nurses and doctors is considered to be a problem. The workflows between the two professions are fairly divided but great communication is fundamental. Today, a "we-and-them"-feeling can be noticed, something that creates frustration and affects efficiency negatively.

Moreover, the scheduling of the two professions is separated, implying that the teams are different every shift. This, together with the ground problem that the doctors work part-time or during shorter periods, leads to a considerable problem with inconsistency and it is essentially impossible to create a good team spirit.

Lastly, as is well known, the children's emergency room is divided into medicine and orthopaedics/surgery. There is a clear line between these areas. The ability to assist the opposing side is limited in some cases by rules of authority. Clearly, better cooperation would be possible and beneficial.

Leadership

There is a lack of transparency about who is the actual leader in the day-to-day work at the unit. The lack of a leadership role means that confusion can easily arise, as well as a lack of clarity about where the staff should turn in the event of problems. This is mainly shown by doctors who are not permanently employed at the emergency department, who often turn to different people (not all of whom are their managers) for complaints. The absence of a leader can also be a reason for the occasional lack of cooperation between doctors and nurses. As

doctors and nurses do not have the same leader, there is a lack of governance that coordinates the groups in certain situations.

However, it is important to point out that in emergency situations the same type of control from a leader is not needed, but in these situations the teams function independently. The leadership role that is most evident for the nurses in their daily work is the nurse in charge of the day. She structures the tasks from the nursing centre in the middle of the room. Rotation of this role takes place partly at each shift and partly internally within each shift team on a daily basis.

The process

The system boundary for the student project was to study the emergency department from "doorstep in" to "doorstep out":

1. All patients who arrive under their own power at the reception are registered at the reception after waiting in the waiting room (except for the emergency cases that require immediate treatment which are directly attended to in an emergency room). The waiting room is a room with sofas, chairs and a device where you take a number slip.

2. Registration takes place in a reception area by a nurse or assistant nurse who makes an initial assessment of how the patient is doing. The registration process takes a few minutes per patient.

3. The patient is then referred back to the waiting room.

4. The patient is then placed in an examination room by a nurse calling out the patient's name.

5. Once the patient is in the examination room, a nurse comes and makes a triage assessment. Triage is the prioritization and sorting process used to separate the influx of patients. Walking patients arrive via the entrance to reception, while ambulance patients are usually transported directly via the ambulance intake to the triage rooms. In the triage process, the patient is assessed according to medical severity and then sent to the relevant medical specialty. The aim is to prioritize the patient flow in order to provide the right care to the right patient with current resource availability.

6. After the triage and a short wait in the examination room, the patient sees a medical doctor or orthopaedics/surgery doctor depending on the condition. The result is further investigation (e.g. X-ray or sampling), going home or transport to another part of the hospital.

The students have observed the following patient flow during the peak hours:

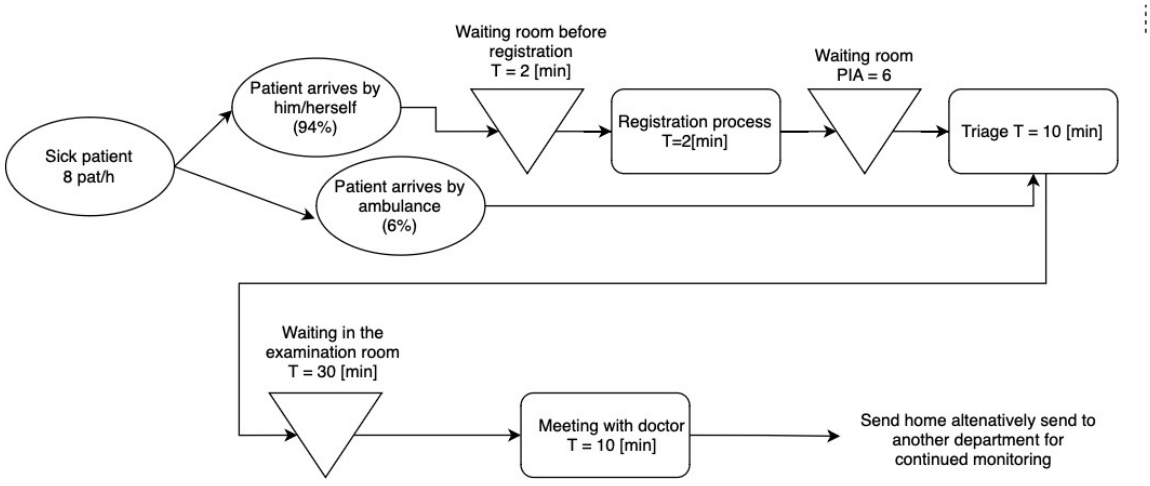

Figure 3: Patient flow

Additional problems that are affecting the patient flow:

- The emergency department has communication problems with the care departments when finding a place for the admitted patients (emergency patients who cannot be sent home but need care). There is a special nurse responsible for occupancy, whose task is to find and coordinate the beds for the wards.

- The nurses and assistant nurses want to see The Department Manager and the Care Unit Manager more in the corridors.

- The emergency department has a high staff turnover among the nursing staff.

- The care staff feel that the operation is disorganized and has unclear areas of responsibility.

- The emergency department does not control the entire medical staff (the doctors "come down" from other departments and work in the emergency department for a short period). The nurses believe that there is a lack of consistency and competence when it comes to the doctors and that responsibility and authority do not go hand in hand. The Department Manager is responsible for reducing throughput times but lacks the authority to select doctors and control external processes.

- The emergency department cannot influence the lead times in the X-ray and test response processes, i.e. when the patient is sent to e.g. X-ray there are long waiting times, which makes the throughput times longer. The doctors in the emergency department often have to wait for results from the X-ray department before they can make a decision.

- Nursing staff and doctors believe that there are too many primary care patients who should seek care in primary care (scheduled care) instead.

- The emergency department is also a training place for future doctors, nurses, police officers, etc., which "disrupts" the daily care production.

- The patient needs to recount his medical history on several occasions (first at reception, in the examination room, triage with the nurse and then to the doctor).

- Personalities of doctors and nursing staff affect variations in the flow. You must be stress- resistant, make quick decisions, be able to delegate, and be interested in meeting patients, even if it is simple cases such as runny nose and cough.

- Lack of consistency between planned capacity and the capacity need (the capacity of the emergency department is not matched with the influx of patients).

- There are different interpretations of the mission of the emergency department.
    - There is a lack of clarity on what is an acceptable time for a patient in each process step, e.g. in the waiting room.
    - There are different opinions about what constitutes a "good" throughput time.
    - Managers reason that in some cases a longer waiting time is acceptable because the processes that extend the patient's stay are not owned by the emergency department and thus cannot be influenced, e.g. X-ray.

Questions:

1. The background is extensive and consists of a lot of information. Sort out the most significant problems and challenges based on an operations management perspective. Clarify and highlight them.
2. Propose three improvements that will address the highlighted problems. Describe how the improvements can be practically applied.
3. Describe and rank three factors that you believe will hinder the implementation of your proposed improvements.

If you think that some information is missing, something is unclear, or that the numbers are not correct, point this out and describe how you interpret it, as well as make reasonable assumptions and briefly justify them. Reasoning, discussion and rough calculations are more important than reporting an explicit calculation process. The answers are largely assessed qualitatively based on argumentation and how they are connected to the course material.