Humans in Complex Systems
729G84

Fall Term 2021

Course examiner: Erik Prytz

Course administrator:

V.2

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2 KURSPLAN (SVENSKA)

Huvudområde: Kognitionsvetenskap

Utbildningsnivå: Grundnivå

Fördjupningsnivå: G2F

Kursen ges för:

- Masterprogram i kognitionsvetenskap
- Kandidatprogrammet i kognitionsvetenskap

Förkunskapskrav

Grundläggande behörighet på grundnivå samt Matematik 3b/3c, Samhällskunskap 1b (1a1 och 1a2), Engelska 6 eller Matematik C, Samhällskunskap A, Engelska B (Områdesbehörighet A4/4), samt Godkänt 90 hp från programtermin 1 till 4, inklusive Kognitionsvetenskaplig introduktionskurs 9 hp samt minst en av kurserna Informationsteknologi och programmering 12 hp, Forskningsmetodik och statistik 9 hp eller Kvalitativa forskningsmetoder 6 hp eller motsvarande. Undantag för svenska.

Lärandemål

Efter avslutad kurs ska den studerande kunna:

- ur ett historiskt perspektiv redogöra för och kontrastera centrala teorier inom forskningsområdet mänskligt beteende i komplexa sociotekniska system
- tillämpa teorier och metoder från human factors (HF) och kognitiva system/cognitive systems engineering (CSE) för analys och utvärdering av komplexa människa-maskin-system och joint cognitive systems
- redogöra för relevansen av olika HF-begrepp för att möjliggöra studier av människa-maskin-system
- kritiskt reflektera över perspektiv och teoretiska grunder för systemkomplexitet, samt för design och kontroll av kognitiva system
- analysera hur kognitiva system kan avgränsas utifrån ett kontrollperspektiv
- förklara centrala begrepp och perspektiv på säkerhet i människa-maskin-system
- redogöra för vanliga risk- och olycksanalysmetoder och -modeller för komplexa sociotekniska system

Kursinnehåll

Kursens innehåll är fokuserat på den mänskliga faktorn från ett systemperspektiv. I detta täcks både historiska och aktuella perspektiv på människo-centrerade systemanalyser, t.ex. cybernetik, human factors, och joint cognitive systems (JCS). I kursen ligger fokus på komplexa, tekniska system där människor, maskiner och artefakter och sociokulturella faktorer ingår och hur man ska designa, analysera och utvärdera sådana system från både mikro- och makroperspektiv.

Kursen täcker följande områden:

- En introduktion till systemvetenskap, systemteori, cybernetik, cognitive systems engineering och resilience engineering

- En fördjupning rörande centrala teoretiska koncept från kognitiv och teknisk psykologi och deras användningsområde i studier av komplexa, sociotekniska och kognitiva system
- Hur grundläggande mät- och utvärderingsmetoder från teknisk psykologi (human factors) kan appliceras för att studera komplexa system
- Hur människa-maskin-system, komplexa sociotekniska system och joint cognitive systems kan studeras från mikro- och makroperspektiv
- En översyn av vanliga risk- och olycksanalysmetoder och -modeller.

Undervisnings- och arbetsformer

Kursen innehåller föreläsningar, seminarier och praktiska övningar. Utöver detta ska den studerande utöva självstudier.

Examination

Kursen examineras genom:

1. Individuella inlämningsuppgifter, betygsskala: UG
2. Gruppvisa inlämningsuppgifter, betygsskala: UG
3. Individuell skriftlig tentamen, betygsskala: EC

För Godkänt (E) slutbetyg krävs minst Godkänt (E) på samtliga moment. Högre betyg baseras på den individuellt skriftliga tentamen. Detaljerad information återfinns i studieanvisningen.

Om det finns särskilda skäl, om det med hänsyn till det obligatoriska momentets karaktär är möjligt, får examinator besluta att ersätta det obligatoriska momentet med en annan likvärdig uppgift.

Om LiU:s koordinator för studenter med funktionsnedsättning har beviljat en student rätt till anpassad examination vid salstentamen har studenten rätt till det. Om koordinatorn istället har gett studenten en rekommendation om anpassad examination eller alternativ examinationsform, får examinator besluta om detta om examinator bedömer det möjligt utifrån kursens mål.

Studerande, vars examination underkänts två gånger på kursen eller del av kursen, har rätt att begära en annan examinator vid förnyat examinationstillfälle.

Den som godkänts i prov får ej delta i förnyat prov för högre betyg.

Betygsskala: ECTS, EC

Övrig information

Planering och genomförande av kurs ska utgå från kursplanens formuleringar. Den kursvärdering som ska ingå i varje kurs ska därför behandla frågan om hur kursen överensstämmer med kursplanen.

Kursen bedrivs på ett sådant sätt att både mäns och kvinnors erfarenhet och kunskaper synliggörs och utvecklas.

Institution: Institutionen för datavetenskap

3 COURSE SYLLABUS (ENGLISH)

Main field of study: Cognitive Science

Course level: First cycle

Advancement level: G2F

Course offered for:

- Master's Programme in Cognitive Science
- Bachelor's Programme in Cognitive Science

Entry requirements:

General entry requirements for undergraduate studies and English corresponding to the level of English in Swedish upper secondary education (Engelska B/6) and Social Studies corresponding to the level of Social Studies in Swedish upper secondary education and Mathematics corresponding to the level of Mathematics in Swedish upper secondary education and 90 credits from semester 1 to 4 of the programme and 9 ECTS credits passed in Cognitive Science Introductory Course and Passed at least one of the courses Information Technology and Programming 12 ECTS credits, Research Methodology and Statistics 9 ECTS credits or Qualitative Research Methods 6 ECTS credits. (Exemption from Swedish)

Intended learning outcomes

On completion of the course, the student will be able to:

- Account for and contrast the context and historical development of central theories connected to the study of human behaviour in complex systems, such as cybernetics, systems science, human factors, cognitive systems engineering and naturalistic "cognition in the wild"-perspectives.
- Apply theories and methods from the field of human factors and cognitive systems engineering to analyse and evaluate human–machine systems and joint cognitive systems.
- Describe the role of central human factors concepts in the study of human–machine systems.
- Critically reflect on perspectives and theoretical foundations of system complexity, cognitive systems design, and control of cognitive systems.
- Analyse how a cognitive system can be delimited from a control perspective.
- Explain central concepts and perspectives on safety in human-machine systems.
- Describe common risk and accident analysis approaches and models in human–machine systems.

Course content

The contents of the course are focused on human factors from a system perspective. This covers historical and current approaches to human-centred systems analyses such as cybernetics, human factors, and joint cognitive systems (JCS). The course primarily concerns complex, technical systems that include humans, technology and artefacts, and sociocultural factors, and how to design, analyse, and evaluate such systems from micro and macro perspectives. The following aspects are covered:

- An introduction to systems science, systems theory, cybernetics, cognitive systems engineering, and resilience engineering
- An elaboration on central, theoretical constructs from cognitive psychology and human factors and their function in the context of complex sociotechnical and cognitive systems.
- How to apply fundamental assessment and measurement methods of concepts central to human factors to study complex systems.
- How to analyse human-machine systems, complex systems, and joint cognitive systems from micro and macro perspectives.
- An overview of different risk and accident analysis methods.

Teaching and working methods

This course includes lectures, seminars, practical exercises, and study visits. The student is expected to study independently, individually or in groups.

Examination

The course is examined by:

- Assignments (individual and in groups), grading scale: UG
- Written examination, grading scale: EC

Final grades for the course are based on the written examination, assuming that the assignments have been passed.

If the LiU coordinator for students with disabilities has granted a student the right to an adapted examination for a written examination in an examination hall, the student has the right to it. If the coordinator has instead recommended for the student an adapted examination or alternative form of examination, the examiner may grant this if the examiner assesses that it is possible, based on consideration of the course objectives.

Students failing an exam covering either the entire course or part of the course twice are entitled to have a new examiner appointed for the reexamination.

Students who have passed an examination may not retake it in order to improve their grades.

Grades: ECTS, EC

Other information

Planning and implementation of a course must take its starting point in the wording of the syllabus. The course evaluation included in each course must therefore take up the question how well the course agrees with the syllabus.

The course is carried out in such a way that both men´s and women´s experience and knowledge is made visible and developed.

Department: Department of Computer and Information Science

4 INTRODUCTION TO THE COURSE

This course covers topics in cognitive systems engineering, human factors and general systems theory. The course aims to provide a solid understanding of what, exactly, human factors (and ergonomics) is and how it relates to the system perspective expanded on in cognitive systems engineering.

The course is therefore broad in scope. For this reason, the course literature will not follow a single book – simply because there is no one book that will cover all the learning objectives and course content. Instead, the literature in the course will be a selection of articles and book chapters from a variety of sources. The books are available through the LiU library e-book services. Thus, you should be able to find and read all course literature for free online – either through the e-book services or by looking at the Lisam course page for complementary literature such as the articles.

Please read the following document carefully, as it will likely answer most questions you may have about the course. We will also provide a course introduction during the first week of the course – check the course schedule on TimeEdit for details. We hope that you will find this course both educational and interesting.

Erik Prytz & Björn Johansson

5 TEACHERS AND STAFF

Erik Prytz (erik.prytz@liu.se) at the Department of Computer and Information Science (IDA). Lecturer, seminar leader, and course examiner.

Björn Johansson (bjorn.j.johansson@liu.se) at the Department of Computer and Information Science (IDA). Lecturer, seminar leader.

Sanna Karlsson, course administrator.

6 COURSE ADAPTATIONS DURING DISTANCE MODE

LiU will operate in a hybrid mode consisting of both on-campus and distance education during the fall term of 2021. The following changes will be made to this course:

- Online lectures
- Online seminars
- No study visits

The lectures will take place online instead of on campus. Some lectures will be provided as recorded lectures via Microsoft Stream, and others will be conducted live using Zoom. A weekly schedule that covers what videos to watch each week will be published on Lisam. The guest lecturers will conduct their lectures live via Zoom, in a format of ca 45-60 minutes of presentation following a scheduled 45-minute slot for discussions and questions. We kindly ask you to have your webcams enabled and microphones muted during the live lectures.

The seminars will be conducted live online via Zoom. For the online seminars we ask all students to have a video-feed on to make turn-taking and speaking engagement easier for all involved. Microphones should be muted when not in use.

The course normally features study visits to relevant work locations, such as control rooms in different domains. However, due to the restrictions placed on visits and to minimize the spread of infections no study visits will be conducted in the fall of 2021.

6.1 CODE OF CONDUCT FOR DISTANCE EDUCATION

This code of conduct is written to clarify what we as teacher expect of you as students during distance education, and what you can expect from us teachers:

- Online sessions should be treated as any other educational activity; respect the teacher's and fellow students' time and focus fully on the educational activity without other distractions.
- Everyone should join the online sessions in a timely manner, i.e. a few minutes before the scheduled start, so that it can start on time.
- For live lectures and seminars, students and teachers should have a web camera feed on.
- Everyone should mute their microphones when not speaking.
- Everyone should join online sessions using a stable connection to prevent drop-out issues. If anyone lacks or has unreliable home wi-fi, that person is expected to find alternative solutions (e.g., joining from a room on campus using Eduroam).
- Everyone must be mindful of speaker turn taking during the seminars, and make sure that everyone gets the chance to talk. Hand raising functions in Zoom can be used for both seminars and lectures to indicate that you wish to say something.
- To prevent "Zoom-bombing", passwords will be used for live sessions. Do not distribute these passwords to anyone outside the course.
- If you are not already familiar with Zoom, take a look at the guide available at LiU's website: https://www.student.liu.se/itsupport/zoom-student?l=sv

7 COURSE LITERATURE

The course will primarily use published articles and individual book chapters as course literature. Most of the book chapters are all available as e-books from the LiU library and are marked as such in the literature list. For the remaining book chapters, copies are made available on Lisam Thus, there is no need to purchase any of the listed books. Use the library website and databases to access the e-books (note that you must be logged in to the library website).

Articles:

1. Bainbridge, L. (1983). Ironies of automation. In *Analysis, design and evaluation of man–machine systems* (pp. 129-135). Pergamon.
2. Baxter, G., & Sommerville, I. (2011). Socio-technical systems: From design methods to systems engineering. *Interacting with computers*, *23*(1), 4-17.

3. Boulding, K. E. (1956). General systems theory—the skeleton of science. *Management science*, *2*(3), 197-208.
4. Bradshaw, J. M., Hoffman, R. R., Woods, D. D., & Johnson, M. (2013). The seven deadly myths of" autonomous systems". *IEEE Intelligent Systems, 28*(3), 54-61.
5. Dekker, S., & Hollnagel, E. (2004). Human factors and folk models. *Cognition, Technology & Work*, *6*(2), 79-86.
6. Hetherington, C., Flin, R., & Mearns, K. (2006). Safety in shipping: The human element. *Journal of safety research, 37*(4), 401-411.
7. Hopkins, A. (2014). Issues in safety science. *Safety science*, *67*, 6-14.
8. Hughes, G., & Kornowa-Weichel, M. (2004). Whose fault is it anyway?: A practical illustration of human factors in process safety. *Journal of hazardous materials*, *115*(1-3), 127-132.
9. Klein, G. A., & Calderwood, R. (1991). Decision models: Some lessons from the field. *IEEE Transactions on Systems, Man, and Cybernetics, 21*(5), 1018-1026.
10. Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2000). A model for types and levels of human interaction with automation. *IEEE Transactions on systems, man, and cybernetics-Part A: Systems and Humans*, 30(3), 286-297.
11. Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2008). Situation awareness, mental workload, and trust in automation: Viable, empirically supported cognitive engineering constructs. *Journal of cognitive engineering and decision making*, *2*(2), 140-160.

Book chapters:

1. Salvendy, G. (Ed.). (2012). *Handbook of human factors and ergonomics*. ProQuest Ebook Central. [e-book]
    a. Chapter 1. The discipline of human factors and ergonomics [note: you do not need to read sections 7 and 8]
    b. Chapter 2. Human factors engineering and systems design
    c. Chapter 57. Human factors and ergonomics in healthcare
    d. Chapter 61. Human factors and ergonomics in aviation
2. Helander, M. (2005). *A guide to human factors and ergonomics*. CRC Press.
    a. Chapter 1. Introduction to human factors and ergonomics
3. Salmon, P. M., Stanton, N. A., Lenné, M., Jenkins, D. P., Rafferty, L., & Walker, G. H. (2011). *Human factors methods and accident analysis: Practical guidance and case study applications*. ProQuest Ebook Central [e-book]
    a. Chapter 1. Accidents, accident causation models and accident analysis methods
4. Hollnagel, E., & Woods, D. D. (2005). *Joint cognitive systems: Foundations of cognitive systems engineering*. CRC press. [e-book]
    a. Chapter 1. The Driving Forces
    b. Chapter 2. Evolution Work
    c. Chapter 6. Joint Cognitive Systems
    d. Chapter 7. Control and Cognition
    e. Chapter 8. Time and Control
5. Hollnagel, E. (2016). *Barriers and accident prevention*. Routledge. [e-book]
    a. Chapter 1. What is an accident?
    b. Chapter 2. Accidents causes and consequence
    c. Chapter 3. The search for causes
    d. Chapter 4. The need for accident models

6. Noyes, J., Cook, M., & Masakowshi, Y. (Eds.). (2007). Decision making in complex environments. ProQuest Ebook Central [e-book]
    a. Chapter 1. Decisions about "What" and decisions about "How"

8 LECTURES

The following lectures are planned for the course. There is also a "weekly plan" on Lisam to help you plan your studies. The plan will list which videos we expect you to watch for each week of the course along with the literature to read. Although this is merely a suggested schedule, we encourage you to use it to plan and structure your studies. In addition, the schedule will list the assigned readings for that week. The assigned reading is meant to complement the videos listed for that week.

Week	Topic	Planned mode	Teacher
36	Course Introduction	Zoom.	Erik Prytz, Björn Johansson
	HF1 - History and definition of human factors	Pre-recorded.	Erik Prytz
37	HF2 – Applied examples	Pre-recorded.	Erik Prytz
38	SP1 - Systems perspective 1	Pre-recorded.	Björn Johansson
	Guest lecture: The maritime domain	Zoom.	Gesa Praetorius
39	SP2 - Systems perspective 2	Pre-recorded.	Björn Johansson
40			
41	Guest lecture: The healthcare domain	Zoom.	Carl-Oscar Jonson
	Guest lecture: The aviation domain	Zoom.	Magnus Nylin
42	CSE - Cognitive Systems Engineering	Pre-recorded.	Björn Johansson
43	RA - Risk and accident analyses	Pre-recorded.	Björn Johansson

8.1 ZOOM-LINKS AND RECORDED LECTURES

You can find the recorded lectures via Lisam. There will be a link in the left-hand side menu to "Recorded Lectures". This will take you to a Microsoft Stream channel for this course, where you will find the videos. Videos will be added successively during the course.

For all activities held in Zoom you will find a Zoom-link on Lisam. There is a schedule provided on the start page of the Lisam course room (right underneath the news section). The links and passwords are listed in that schedule. Do not distribute these links or passwords to individuals outside of the course. Note also that the Lisam-schedule only shows the next five upcoming activities, and that the Zoom-links will be added 14 days in advance. Check the schedule weekly for the latest updates.

8.2 Q&A SESSIONS

Question and answering sessions have been added to this course to compensate for the fact that you cannot ask questions during the pre-recorded lectures. The Q&A sessions are for you students to ask questions on the material covered to date in the course, particularly for pre-recorded lectures. These sessions will also function as advising sessions for the group project.

The Q&A sessions are not live lectures. The teachers will be available to answer questions and discuss the material but will not repeat the lectures. As such, these sessions will build completely on the questions that you students bring. These types of educational activities are sometimes referred to as flipped classroom. In short, the teachers will be available to help you understand the material and progress in your group project by answering any question you may have.

The Q&A sessions will start on the designated time and continue for as long as there are questions (or until the scheduled time runs out). When there are no more questions from the students, we will close the session. Further, the session will end 15 minutes after the scheduled starting time if no students have joined at that time. Thus, even though the sessions are scheduled for two hour they will only be active from the starting time and until the questions have been answered.

9 SEMINARS

The course includes four seminars. The seminars include at least two articles each, sometimes with contrasting views. You are expected to read the articles and reflect on the content prior to the seminar. There is also an individual assignment associated with each seminar – see section 11.2 and 11.6 for more details.

#	Topic	Literature
1	Perspectives on automation	Bainbridge, L. (1983). Ironies of automation. In *Analysis, design and evaluation of man–machine systems* (pp. 129-135). Pergamon. Bradshaw, J. M., Hoffman, R. R., Woods, D. D., & Johnson, M. (2013). The seven deadly myths of "autonomous systems". *IEEE Intelligent Systems, 28*(3), 54-61. Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2000). A model for types and levels of human interaction with automation. *IEEE Transactions on systems, man, and cybernetics-Part A: Systems and Humans*, 30(3), 286-297.
2	Perspectives on situational awareness	Dekker, S., & Hollnagel, E. (2004). Human factors and folk models. Cognition, Technology, and Work, 6, 79–86. Sheridan, T. B., & Wickens, C. D. (2008). Situation Awareness, Mental Workload, and Trust in Automation: Viable, Empirically Supported Cognitive Engineering Constructs. Human Factors, 2(2), 140–160. doi:10.1518/155534308X284417.
3	Decision making in complex systems	Noyes, J., Cook, M., & Masakowshi, Y. (Eds.). (2007). Decision making in complex environments. ProQuest Ebook Central [e-book, Chapter 1] Klein, G. A., & Calderwood, R. (1991). Decision models: Some lessons from the field. *IEEE Transactions on Systems, Man, and*

		Cybernetics, 21(5), 1018-1026.
4	Perspectives on risk and accidents	Hopkins, A. (2014). Issues in safety science. *Safety science*, *67*, 6-14. Hughes, G., & Kornowa-Weichel, M. (2004). Whose fault is it anyway?: A practical illustration of human factors in process safety. *Journal of hazardous materials*, *115*(1-3), 127-132.

10 STUDY VISITS

Unfortunately, no study visits will be offered during the course due to the COVID-19 pandemic and current restrictions placed on LiU and the Swedish society in general.

11 EXAMINATIONS

The grade in the course is based primarily on a written exam, but also individual and group assignments. The individual assignment is done as part of the seminar series.

11.1 WRITTEN EXAM

The written exam is a take-home test. You will have one week to complete the exam. The questions will require you to integrate knowledge from multiple sources (readings, lectures, seminars). You may discuss the questions in study groups, but each student must write their own answers in their own words. Additional, specific information will be provided with the take-home exam. For this exam, an abridged ECTS grade is provided (A, C or Fx).

11.2 INDIVIDUAL ASSIGNMENT AND SEMINARS

There is an individual assignment associated with each seminar. The assignment is to submit at least two discussion questions per seminar article before the specified deadlines (see the section on Deadlines in this document). The discussion questions submitted by all the students will be used to create a supporting document with different topics for the seminar. When writing the discussion questions, keep in mind that it should be **relevant** to the seminar topic, **grounded** in the material you have read, and **interesting** to pose as a question in a group discussion.

The submitted questions and your presence during the seminar is the individual assignment portion of the course grade. You can receive a pass (G) or fail (U) on this part. You must receive a pass to complete the course. You must complete make-up work if you fail to submit questions or submit questions that are deemed to be off-topic, irrelevant or poorly written (unintelligible), or if you are not present during the actual seminar. The make-up work is explained in section 11.6.

11.3 GROUP ASSIGNMENT

The group assignment will be conducted in groups of ca 4-5 students. The purpose of the group assignment is to 1) identify, describe, and delimit a complex, socio-technical system, 2) identify potential human factors issues within this system, and 3) suggest and describe ways of further investigating and exploring the impact of those issues on overall system performance. This assignment is graded on a pass (G) or fail (U) basis.

The assignment is divided into three phases, as described below. Each phase is planned to take about 2-3 weeks and will have separate submissions and deadlines during the course. The point is to gradually work on and develop your final assignment. Feedback will be given on each submission, but only the final submission at the end of the course (which will include revised versions of the previous assignments) will be assessed and used to determine your grade.

Keep in mind that all three phases are meant to build towards a single, final report. Thus, even though each phase has different focus they should be seen as sections in a cohesive report. You are highly encouraged to read through the description of all phases of the project (below) and create a draft document that covers all parts. This will help you create a unified report at the end.

11.3.1 Phase 1

For the first phase, your task is to select some form of complex, socio-technical system and describe the important components and functions of this systems. Examples of such systems are, for example, nuclear power plants, hospitals and other healthcare institutions, aviation and air traffic control, maritime traffic control, ship navigation, process industry, motor vehicle transportation, petrochemical plants, manufacturing industries, military operations, emergency response systems, mining, offshore oil platforms, hydroelectric dam operations, and many, many others.

For your chosen system you should provide a general overview of the purpose and function of the system. You must also delimit a specific subsystem within this system which you will investigate in further detail. This could be, for instance, the emergency department in a hospital, or even a trauma team within the emergency department of a hospital; or it could be the control room of a hydroelectric dam, or a specific workstation within the control room of a hydroelectric dam. You are free to determine for yourself the limits of the subsystem and what you deem appropriate to include and exclude in that subsystem. You should carefully describe and motivate which parts of the overall system you choose to include or exclude from your chosen subsystem. For the specific subsystem, you should then describe the important components and functions in as much detail as you are capable of, provided your available sources and page limits (described below).

In summary, for Phase 1 you should 1) select a complex, sociotechnical system and describe this at a high, overarching level in terms of purpose and functions, 2) delimit a particular subsystem within the overall system and describe this in more detail with respect to the purpose, goal and function of the subsystem and the most important components (e.g., operators, machines, interfaces, etc.). You can choose to describe a *general* form of the chosen system, i.e. how a generic hospital works, or you could choose to describe a specific implementation of the chosen system, i.e. how Linköping University Hospital, specifically, works. It is recommended that you structure your written report based on these two parts and first describe the general system, followed by a description of the chosen subsystem.

The written part for Phase 1 is expected to be approximately three to four pages of text, not including title pages, indexes, tables of content, images or references (for simplicity, consider ca 500 words to equal one page of text). However, there is no strict minimum or maximum page requirements. For this part you are encouraged to use suitably credible "gray literature", i.e. non-scientific sources, to gather information and further your understanding of the system you have chosen. It could be textbooks, news articles, online virtual tours, websites, YouTube tours or walkthroughs, documentaries, podcasts, and similar. You may also, if you are so inclined, contact professionals working within such systems to ask questions about particular topics. If any group member has previous experience of work within the type of complex system you have chosen you may also rely on that personal experience and understanding. You are expected to critically evaluate the accuracy of the sources you choose and cite them as appropriate in your text.

Finally, the written report you submit for Phase 1 should be considered a *rough draft* of your final product. You will have the opportunity to revise this text twice before the final submission. Thus, you do not have to feel a need to have something perfectly done – a rough draft is what we expect. Again, keep in mind that the written part for Phase 1 is only one part of the final, complete report.

11.3.2 Phase 2

In Phase 2, your task is to 1) identify a potential human factors-related issue within your selected system, 2) give a brief theoretical overview of this type of issues, and finally 3) describe the potential impact of this issue on the overall system performance (for both the specific subsystem and the larger system of which it is a part).

Human factors, as will be described in more detail during this course, is a broad term that can encompass more or less any problem or issue that involves human performance within the context of socio-technical systems. Perceptual, cognitive, physiological, and social issues all fall in under this term, as does issues related to human-machine interfaces, teamwork, personnel selection and training, performance in extreme environments, individual differences, aging, and many more (as will be described in the lectures on human factors). Thus, for virtually any system of appreciable complexity there is bound to be some aspects where we can use our knowledge of human strengths and limitations to identify potential problems. Your task is to brainstorm and gather information to do just that.

To continue the example from Phase 1, if you choose to look at hospitals as the overall system and the trauma team within an emergency department as your particular subsystem, you may identify issues such that:

- the team members could become tired after a particularly bad trauma case leading to poor performance for subsequent cases (which is related to theories about *fatigue*),
- the team must understand and predict how complicated trauma cases will evolve over time (situational awareness),
- the trauma team must coordinate their activities amongst themselves to optimize performance (team communication),
- a particular piece of medical equipment is vital to the care for certain types of medical cases and must be able to be used correctly and quickly (tool design),
- there are multiple approaches to prioritizing among all the patients who show up, so called triage, and that the decisions made in terms or prioritization could impact patient outcomes (decision making),

- trauma teams may work differently in different hospitals, yet staff is shifted around and have to quickly be able to pick up on how trauma codes are managed at that particular hospital (personnel training),
- the trauma team currently must wear facemasks and shields to prevent COVID-19 infections which adds an additional component to an already hectic working environment (personal protective equipment use),
- some hospitals are introducing automated cardio-pulmonary resuscitation machines (e.g., the LUCAS device[1]) to manage cardiac arrest patients, which has implications for how the trauma team should work (automation)
- there is a surprisingly high rate of medical administration errors where patients receive either the wrong medication or the wrong dose of medication (human error), or
- due to the ongoing pandemic the emergency department is severely short-staffed, and each trauma team must manage a larger-than-average number of patients (workload).

You may identify several, potential issues. Select *one* of those which seem the most relevant (i.e., plausible that it could exist within the system and with a potential to impact system performance) and provide a brief overview of one or more relevant human factors related theories that can help us understand this problem. For example, if you believe that one relevant issue for emergency department trauma teams is that they will be tired after receiving particularly severe trauma cases and thus more likely to underperform for subsequent cases you could provide an overview of theories related to *fatigue* and the effects of fatigue on human and system performance. Your theoretical overview would thus provide information on *fatigue* as a general concept.

In summary, the written report you produce for Phase 2 should include 1) the identification of one or more potential human factors-related issues within the subsystem you described in Phase 1, and 2) a theoretical overview of relevant human factors literature on the topic of that issue. You should also clearly describe how the problem or issue may potentially impact system performance for both the subsystem and the general system of which it is part.

The written report from Phase 2 is expected to be add about three pages to your submission from Phase 1. For the theoretical overview you are expected to use scientific sources, primarily published articles but also book chapters from credible, technical texts (such as, for example, other chapters from the books listed in the course literature). You should provide firstly a general description and overview (e.g., definitions of central concepts, important basic findings) as well as, if possible, more specific examples from studies that are closer to the subsystem you are analyzing.

Finally, the written report you submit for Phase 2 should include both the new text as well as a revised version of the text you submitted for Phase 1. You should integrate the two parts into one, coherent document. The revisions to the text from Phase 1 may be, for example, additional information on the general or particular systems that you have discovered during your work on Phase 2, clarifications and simplifications of the description, removal of irrelevant parts, or to shift focus to a more appropriate subsystem given your current understanding of the systems and the issues of interest. The revisions may be minor or feature major re-writings – that is entirely up to you. You

[1] https://www.lucas-cpr.com/

must append a *change log* where you, briefly, describe the changes you have made. Again, you should consider the text that you submit for Phase 2 to be a *draft* of the final product, and you will have the opportunity to revise it once more before the final submission.

11.3.3 Phase 3

Your task in Phase 3 is to describe ways of further investigating or exploring the potential issue you identified within the selected system. If necessary, specify details in a given instantiation of the general class of systems you have described (e.g., describe a specific emergency room department at a specific hospital, if you have previously described emergency room departments in general without focusing on any one particular emergency room). Specify how you would go about to measure variables relevant to the issue you described in Phase 2, and how you would attempt to relate these to the overall system performance. Consider what good measures of system performance could be for the particular system you have chosen, and how data on those measures could be collected. Consider also what existing, validated methods and measures are available in the human factors literature that you could use to investigate your chosen issue. Note that you will likely have to search outside of the literature included in this course to find good sources (but see also the optional reading list at the end of this document, e.g. Noyes, Cook, & Masakowski (2012) or Stanton, Salmon, & Rafferty (2013)).

Essentially, you are asked to answer the question: "how can we investigate if the issue you have identified is really a problem or not?".

The text you produce in Phase 3 should thus include 1) a description of different methods and measures of system performance for your chosen system and subsystem, 2) a description of different methods and measures related to the particular theoretical concept you described in Phase 2 and the specific issue in relation to the system of choice, and finally 3) a motivated choice of method and accompanying method discussion of the implications this choice of method(s) will have on your ability to evaluate the potential impact of your chosen human factors issue. The text is expected to be about three pages long, although there is no strict page requirement.

As in Phase 2 you should incorporate all three parts (from Phase 1, 2, and 3) into one, coherent document. You should also review and revise your previous parts (from Phase 1 and 2) given the knowledge you have acquired during the course and the new insights you have from Phase 3. To create a coherent document, it is recommended that you at this point write a brief introduction if you have not already done so, as well as an abstract and a concluding section along with a title page, table of content, and similar.

A final component in your submission is a description of author contribution. That is, you are asked to evaluate, in your group, to what extent each individual group member meets the following criteria:

Criteria	Sample evaluation questions to discuss within the group
1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND	In Phase 1, did each member contribute to the initial discussions around choosing a system to analyze? In Phase 2, did each member contribute to identifying different human factors-related issues,

	or suggested concepts to review? In Phase 3, did each member contribute to the group discussions on the methodological choices? For all phases, did each member engage in active work to find relevant articles and other sources of information that helped the group forward in the project?
2. Drafting the work or revising it critically for important intellectual content; AND	For all phases, did each member contribute by writing text that were later used in the final version? Did each member edit the report for important intellectual content, and not merely minor language revisions? Was there an imbalance such that some members did more or most of the writing and others did significantly less?
3. Final approval of the submitted version; AND	Did all members agree to submit the version you submitted?
4. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.	Did all members agree that they are accountable for all aspects of the submitted work?

These four criteria are known as the *Vancouver recommendations*[2] for assigning authorship in scientific publications, particularly within the medical sciences. In this particular instance, you are asked to consider if each group member meets these criteria and should thus be considered an "author" of your submitted work. Only those who are considered authors will receive a grade on the assignment based on the submitted work, and conversely any potential academic dishonesty problems (e.g., plagiarism, see chapter 11.8 in this course syllabus) will be held against all authors (see criteria 4). This authorship evaluation component is to ensure that there is a measure of *individual assessment* in this group project, i.e. to ensure that each individual student has performed sufficient work to be given a passing grade.

It is generally expected that all members in a group meet these four criteria outlined above, unless there have been some *significant* issues related to the division of labor within the group (e.g., one or more students that have contributed significantly less than others). It is also expected that such group dynamic problems have been brought to the teachers' attention as soon as they arise, rather than being seen only in this final evaluation. It is natural in all group projects that there is a division of labor (e.g., some may be assigned to search for literature, and some to write particular sections). It is also natural that the work is not perfectly balanced among all members, and that some members may contribute more in some phases than others. None of that is a cause for concern nor should it be considered grounds for excluding a group member from authorship. However, in those cases where one or more group members has

[2] http://www.icmje.org/icmje-recommendations.pdf

consistently failed to meaningfully contribute to the work throughout the project there is cause for concern.

In the (default) case that all group members agree that everyone should be given equal credit as author the following phrase should be inserted in the submitted report:

> *"The authors listed on the report unanimously agree that each individual meets the four criteria outlined in the Vancouver recommendations for authorship credit."*

If, on the other hand, there is disagreement or one (or more) group members are excluded from the list of authors, the group should include a specific list of the members that meet the criteria and those that do not, and a (brief) motivation as to why those members were excluded.

11.3.4 FAQ for the group project

Can we pick any system?
As long as you can motivate why your chosen system should be seen as a "complex, socio-technical system", and you believe that you can complete the tasks in all phases given your chosen system, yes.

Is there a template to use for the report?
No, you are free to structure your reports as you see fit. Consider a structure based on the different components of the different tasks. One suggested structure is as follows:

- Title page, including author statement
- Table of contents
- Abstract or summary page with a brief (e.g., 250-300 word) summary of the entire report
- A short "Introduction" section that introduces the report to the reader and explains what will be covered (ca 1 page, likely written during Phase 3)
- A "Background" section that describes the system (the Phase 1 part) along with an identified human factors problem (from Phase 2)
- A "Theory" section on relevant human factors theories that can explain or predict the identified problem (from Phase 2)
- A "Method" or "Suggested study" section that outlines a way to study the identified problem (from Phase 3)
- A short "Concluding remarks" or "Discussion" section that ties everything together (perhaps 1-2 pages, written during Phase 3)
- A "References" section, which is continually expanded and updated throughout the project work.

However, this is merely a suggestion, and you may find another format that fits your report better.

How detailed must we be when describing the system?
You are not expected to fully understand or be able to describe complex systems, such as nuclear power plants, in great detail given primarily online resources. A general description is sufficient, and we would expect you to include more details for the particular subsystem you analyze in more detail – and of course this might be added during the revisions in later phases.

We picked an interesting human factors-problem, but when we looked into it there is already a solution in place for that problem – what do we do?
You have several options. One, you could shift your attention to another of the problems you discussed before picking that particular problem. Two, if the solution is only present in some instances of the system and not others (e.g., that particular solution is only present in some hydroelectric dam control rooms but not all of them) you could proceed as planned and focus on instances where the solution is not present. Three, you could pose the hypothetical question of whether the solution is, indeed, solving a real problem or not, and proceed as planned with the idea that you could remove the solution from a system and then further investigate if this actually creates problems.

Can we change the system we picked in the later phases?
Yes, but you would of course have to re-write the earlier texts.

Will we fail if we don't submit partial reports for the different phases?
No – only the final submission will be assessed and given a grade. However, you will not receive any feedback on your work during the course either.

How many pages should the final report be?
Given the expected page count for each individual phase – perhaps around 10 pages, not including standard parts such as title page, table of content, references, and large or numerous images. However, there is no strict limit or required minimum. Your report should adequately address the tasks given in each phase, and that is the important part. We prefer concise texts over verbose, provided that the clarity does not suffer from the brevity.

Can we divide different tasks among us? How does that work with the authorship part?
Yes, feel free to divide the tasks and distribute the labor. Everyone should be considered an author as long as everyone agrees that each group member contributes important intellectual content – it does not have to be the exact same intellectual content.

How much time are we expected to put into the project?
One way of looking at it is to say that the assignment is worth 3 HP, i.e. 80 hours of studying per group member or about 320-400 hours total distributed in a group of 4 to 5 members. The project is also distributed over 10 weeks, which comes down to about 8 hours per member per week. Another way to look at it is that this project is designed to help you understand the material in the course and is, of course, integrated with the other readings and lectures you will partake in. Thus, the time spent working on the project may amount to more than 80 hours per member because some of the necessary readings are the same as the readings for the course in general.

11.4 Deadlines

All deadlines are for 17:00 on the day noted, unless otherwise specified. A one-hour grace period will be added in the Lisam submission system, such that Lisam will accept submission up to one hour after the formal deadline. This grace period is to allow for unforeseen troubles with the submission procedure. Once the Lisam submission system closes, the assignment is formally considered late (see 11.5).

11.4.1 Individual assignments (seminar questions)

- Seminar 1: Monday 13/9
- Seminar 2: Monday 27/9

- Seminar 3: Monday 11/10
- Seminar 4: Monday 25/10
- Make-up work: Friday 5/11

11.4.2 Group project

- Phase 1: Friday 17/9
- Phase 2: Friday 8/10
- Phase 3: Friday 5/11 (final, graded submission)

11.4.3 Written exam

- Published: Friday 5/11
- Deadline: Friday 12/11

11.5 Late assignments

Late assignments, i.e. those handed in after the Lisam submission closes, will be reviewed and graded by the next re-examination date. Exemptions to this policy can be considered on a case-by-case basis, e.g. for serious illness requiring hospitalization, deaths in the family, or similar, by the course examiner (Erik Prytz). A request for exemption should be submitted as early as possible, and before the deadline in question.

11.6 Make-up work and re-examination

Submitted assignments that are close but not quite at a passing level may be given a make-up work grade, "K" (Sw. "komplettering"). This is given on a case-to-case basis and only for assignments that are deemed to be very close to passing quality with minor revisions. In those cases, an individual deadline is also provided for when the revised assignment must be re-submitted. The deadline is usually within six weeks of the previous deadline. An assignment that is revised in this manner can only receive a passing grade (ECTS: C), and nothing higher.

For the individual assignment, there is an opportunity to complete make-up work during the course. If you fail to submit questions or be present at the seminar you can write a summary of the literature for that seminar (ca. one page per article or book chapter), and include a one-page answer to one of the posted discussion questions from the discussion guides (which will be available on Lisam). You submit all make-up work for the individual assignments at one time in one document, before the deadline listed under 11.4.1.

If you receive a failing grade (ECTS: F) on any assignment you will have to complete a re-examination (Sw. "Omexamination"). Re-examination opportunities are offered two times before the start of the next course, at which point you will instead have to complete that years' corresponding assignment. Each re-examination will be a new examination, e.g. a new written exam with new questions.

11.7 Re-examination deadlines

The re-examination deadlines are:

- 2022-01-14
- 2022-05-16

For the take-home exam, a new exam will be published on Lisam one week prior to the deadline listed above. You must sign up to take the new take-home exam. You do this on Lisam using the "Sign up" ("Anmälan") function. This signup closes 15 business days prior to the deadline. No exam will be published if no students have signed up at that point.

11.8 PLAGIARISM AND ACADEMIC DISHONESTY

As with all courses at LiU, plagiarism and academic dishonesty is not allowed. All such instances *will* be reported to the Disciplinary Board, and may result in a disciplinary action such as a suspension. The decision to report a suspected attempt to cheat is not made by the course examiner. The course examiner *must* report such attempts as per the university guidelines:

"Suspected attempts at cheating and disturbances of the peace shall be reported to the Vice-Chancellor and the matter treated by the University Disciplinary Board." (link to source)

Cheating (from LiU Disciplinary Board):

According to chapter 10 in the Higher Education Ordinance, disciplinary measures can be used against a student who:

1. Uses prohibited aids and equipment, or in any other way, purposely acts inappropriately during the examination or the assessment of a study assignment.
2. Causes disturbance, prevents teaching, examinations or other university related activities from taking place.

Examples of what LiU's Disciplinary Board has judged as cheating:

- text written onto a formula sheet
- loose sheets of paper containing the student's own writing during a test
- plagiarizing an essay
- copying a programming project
- working with another group during individual projects when doing so was not allowed

Plagiarism (from LiU Library):

What is plagiarism?

To plagiarize means using somebody else's work and presenting it as your own without referring to the source. It may be a text, idea, theory, image, chart, figure, music, computer program or a product. Even reformulation, paraphrasing, text to your own words, without referencing the source is plagiarism. Plagiarism may also violate Copyright laws.

What happens if I plagiarize?

Plagiarism is a serious offense against good academic practice and can if worse comes to worst result in temporary suspension from studies by decision of The Disciplinary Board at Linköping University. A student who is suspended may not participate in lectures, laboratory sessions, seminars, exams, tutorials, assignments, and may not access to LiU's computer labs. The suspension may also affect payment of student support.

11.8.1 Clarifications for the current course

- The take-home exam and the individual assignments (seminar questions) must be written individually. You may discuss these assignments amongst yourselves and in study groups, but the submitted text must be written individually.
- Proper referencing must be used when referring to, paraphrasing, or recounting someone else's words or ideas.
- Direct translations of English text to Swedish is considered plagiarism unless re-written with your own words and properly referenced.

12 SUGGESTED AND OPTIONAL READING

Below we list some additional literature that you can read on your own if you are interested. If you are struggling with or want to know more about a concept you might find this additional material helpful, or if you are looking for inspiration for your group project. Most of the books listed below are available as e-books through LiU.

Books and book chapters:

- Carayon, P. (Ed.). (2011). Handbook of human factors and ergonomics in health care and patient safety. ProQuest Ebook Central
- Dekker, S. (2016). Drift into failure: From hunting broken components to understanding complex systems. CRC Press.
- Dekker, S. (2016). Patient safety: a human factors approach. CRC Press.
- Hollnagel, E., Woods, D. D., & Leveson, N. (Eds.). (2006). Resilience engineering: Concepts and precepts. Ashgate Publishing.
- Jenkins, D. P. (2009). Cognitive work analysis: coping with complexity. Ashgate Publishing.
- Karwowski, W., Stanton, N. A., & Soares, M. M. (Eds.). (2011). Human factors and ergonomics in consumer product design : Methods and techniques. ProQuest Ebook Central
- Marek, T., Karwowski, W., & Rice, V. (Eds.). (2010). Advances in understanding human performance: Neuroergonomics, human factors design, and special populations. CRC Press.
- Militello, L., Ormerod, T., Schraagen, J. M., & Lipshitz, R. (Eds.). (2012). Naturalistic decision making and macrocognition. Ashgate Publishing.
- Naweed, A., Dorrian, J., & Rose, J. (2013). Evaluation of rail technology : A practical human factors guide. ProQuest Ebook Central
- Noyes, J., Cook, M., & Masakowski, Y. (Eds.). (2012). Decision making in complex environments. Ashgate Publishing.
- Owen, C. (Ed.). (2014). Human factors challenges in emergency management: Enhancing individual and team performance in fire and emergency services. Ashgate Publishing.
- Pariès, J., & Wreathall, J. (2017). Resilience engineering in practice: a guidebook. CRC Press.
- Rafferty, L. A., Stanton, N. A., & Rafferty, L. A. D. (2012). The human factors of fratricide. ProQuest Ebook Central

- Salas, D. E. (2015). Hostile intent and counter-terrorism : Human factors theory and application. ProQuest Ebook Central
- Salas, E., & Maurino, D. (Eds.). (2010). Human factors in aviation. ProQuest Ebook Central
- Stanton, N., Salmon, P. M., & Rafferty, L. A. (2013). Human factors methods: a practical guide for engineering and design. Ashgate Publishing.
- Theeuwes, J., Horst, R. V. D., & Theeuwes, J. P. D. (2012). Designing safe road systems : A human factors perspective. ProQuest Ebook Central
- Wiegmann, D. A., & Shappell, S. A. (2017). A human error approach to aviation accident analysis: The human factors analysis and classification system. Routledge.

Articles:

- Praetorius, G., & Hollnagel, E. (2014). Control and resilience within the maritime traffic management domain. *Journal of Cognitive Engineering and Decision Making*, *8*(4), 303-317.