Video book Project 2

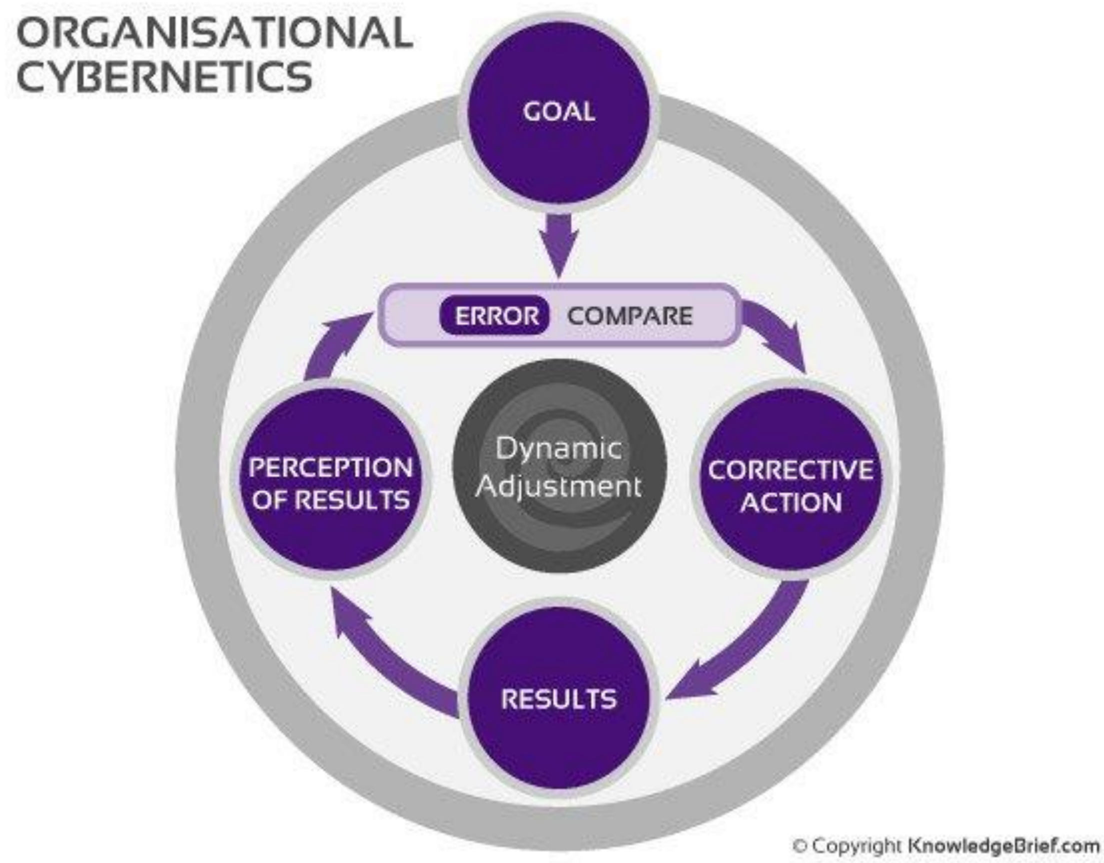
Chapter 2 Automated systems

Automation has been going on for a long time in practically all aspects of human activities. CAD, CAM and CIM have been around for decades with ever increasing sophistication. Automated systems in other spheres of activities are also used increasingly. They are generally task specific. In the home a basic example is a washing machine which runs through different cycles as chosen by the user. In industry, automated factories have been used for decades using Programmable Logic Controllers which receive input from sensors and switches in real time. Using ladder logic they control valves and actuators to carry tasks such as operating mail sorting systems, convey components on assembly lines or control industrial processes acting as a proportional–integral–derivative (PID) loops. Large plants such as a flour mill are now run by about a few individuals. Modifying the software in those controllers, without changing any wiring, allows the plant to work different way and make different products. In mission critical systems malfunctions can have disastrous consequences both financial and to the personnel. Therefore automated systems have to be designed to be failed-safe with duplication of components of the system in order to increase reliability.

The four technologies automation, robotics, virtual reality and artificial intelligence intersect in various degrees. Robotics can be viewed as a sub-set of automation. Artificial Intelligence software is used to power automated systems, robotics and virtual reality. The common elements in all of them is computing power, algorithms of various degrees of complexity and sophisticated sensors of many types.

Theoretical underpinnings

Cybernetics is applicable when a system being analyzed incorporates a closed signaling loop—originally referred to as a "circular causal" relationship—that is, where action by the system generates some change in its environment and that change is reflected in the system in some manner (feedback) that triggers a system change. Cybernetics is relevant to, for example, mechanical, physical, biological, cognitive, and social systems. The essential goal of the broad field of cybernetics is to understand and define the functions and processes of systems that have goals and that participate in circular, causal chains that move from action to sensing to comparison with desired goal, and again to action. Its focus is how anything (digital, mechanical or biological) processes information, reacts to information, and changes or can be changed to better accomplish the first two tasks.[3] Cybernetics includes the study of feedback, black boxes and derived concepts such as communication and control in living organisms, machines and organizations including self-organization (Wikipedia) https://en.wikipedia.org/wiki/Cybernetics



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According to Wiikipedia: "Systems theory is the interdisciplinary study of systems. A system is a cohesive conglomeration of interrelated and interdependent parts that is either natural or man-made. Every system is delineated by its spatial and temporal boundaries, surrounded and influenced by its environment, described by its structure and purpose or nature and expressed in its functioning. In terms of its effects, a system can be more than the sum of its parts if it expresses synergy or emergent behavior. Changing one part of the system usually affects other parts and the whole system, with predictable patterns of behavior. For systems that are self-learning and self-adapting, the positive growth and adaptation depend upon how well the system is adjusted with its environment. Some systems function mainly to support other systems by aiding in the maintenance of the other system to prevent failure. The goal of systems theory is systematically discovering a system's dynamics, constraints, conditions and elucidating principles (purpose, measure, methods, tools, etc.) that can be discerned and applied to systems at every level of nesting, and in every field for achieving optimized equifinality.[1]

General systems theory is about broadly applicable concepts and principles, as opposed to concepts and principles applicable to one domain of knowledge. It distinguishes dynamic or active systems from static or passive systems. Active systems are activity structures or components that interact in behaviours and processes. Passive systems are structures and components that are being processed. E.g. a program is passive when it is a disc file and active whttps://en.wikipedia.org/wiki/Systems_theoryhen it runs in memory.[2] The field is related to **systems thinking** and systems engineering."

https://en.wikipedia.org/wiki/Systems_theory

https://www.google.com/imgres?imgurl=https://i.ytimg.com/vi/Lr2hGvkGp3o/hqdefault.jpg&imgrefurl=https://www.youtube.com/watch?v%3DLr2hGvkGp3o&h=360&w=480&tbnid=WKFa-iroroiHOM:&q=systems+theory&tbnh=150&tbnw=200&usg=AI4_-kThsVUt2GMymXoy4Ta5TKL9faGrBQ&vet=12ahUKEwiz6MT1mMXeAhXFmOAKHSTwA0oQ_B0wFnoECAQQBg..i&docid=ahAl6Az9rHzueM&itg=1&sa=X&ved=2ahUKEwiz6MT1mMXeAhXFmOAKHSTwA0oQ_B0wFnoECAQQBg

It is amazing what automation can do

Let us start by looking at agriculture. In 1900, 42 percent of the United States population of 76 million lived on farms. A hundred years later, the population had nearly quadrupled to 280 million but the proportion of the population living on farms had fallen to 3 percent. The population grew by nearly 400 percent while the proportion of farmers working to feed them all fell by 93 percent. And the population was arguably better fed in 2000 than they were a hundred years earlier. How is that possible? Better agricultural practices, for one thing: crop rotation, contour ploughing,irrigation systems, fertilizers, pesticides, and plant and animal breeding and selection.

But far more important to the development of the food chain has been large degree of mechanization and progressive automation. A case in point is a potato harvester produced by *DoubleL* of Idaho. As it moves non-stop through the potato fields, it chops up the potato plants and turns them into mulch, digs up and scoops the potatoes onto a series of conveyors, shakes, tumbles, and jiggles them until they are free of dirt and other foreign matter, and then pours them into a truck that Is following alongside. When the truck is full and leaves with its precious cargo, the off-loading stops, but the harvesting continues The potatoes being off-loaded are then diverted back into the harvester instead and mixed with the potatoes being harvested long enough for an empty truck to pull into place, at which time the off-loading resumes, while the harvesting continues seamlessly.With a continuous flow of potatoes by the truckload.

Double L: Your Most Resourceful Partner in Agriculture

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What's next? What's needed is a sorting machine capable of handling such large volumes. Such a machine was recently introduced by a Swiss company, *Visar.* Here is how the company describes its totally automatic Visar Sortop Potatoes equipment: "It sorts washed, unwashed (eg: seed potatoes) and peeled potatoes. In addition, it has a unique optical configuration that combines a 360^{o} view with a high resolution (0.16 mm^{2}) and an infrared signal camera.In the course of this the facility is capable to analyze the shape, maturity and peels as well as wireworm infestation in one fell swoop." Remarkably, the Visar equipment is capable of processing up to 30 potatoes per second, or 2.5 tons per hour.

https://www.potatopro.com/companies/visar-sorting

In banking, the ATM was considered quite a breakthrough when first introduced and today their functionalities have increased to make banking more user-friendly. Investing is also increasingly being automated from advising to trading. The same can be said about the business sector in general and in this instance, this is being done in conjunction with robotics, virtual reality and AI technologies and these applications will be explored in the coming chapters.

Airplanes have been using flight automated systems also for decades; the important point is that the airplanes are increasingly more sophisticated. Self-check in by passengers at airports has become routine.
According to Flight Mechanic: “An aircraft autopilot with many features and various autopilot related systems integrated into a single system is called an automatic flight control system (AFCS). These were formerly found only on high-performance aircraft. Currently, due to advances in digital technology for aircraft, modern aircraft of any size may have AFCS”
Flight Mechanic further states that “AFCS capabilities vary from system to system. Some of the advances beyond ordinary autopilot systems are the extent of programmability, the level of integration of navigational aids, the integration of flight director and autothrottle systems, and combining of the command elements of these various systems into a single integrated flight control human interface.”
http://www.flight-mechanic.com/automatic-flight-control-system-afcs-and-flight-director-systems/

https://www.google.com/imgres?imgurl=http://www.flight-mechanic.com/wp-content/uploads/2017/11/10-113.jpg&imgrefurl=http://www.flight-mechanic.com/automatic-flight-control-system-afcs-and-flight-director-systems/&h=1122&w=924&tbnid=-08OlswbzjP28M:&q=automatic+flight+control+system+of+aircraft&tbnh=160&tbnw=132&usg=AI4_-kSUPE2bUfZ7KzpO2LtCzzT7G0FUow&vet=12ahUKEwjU5vKW_sTeAhUEZd8KHZWCDBQQ9QEwAHoECAgQBg..i&docid=-IkXOZQE0DqqjM&sa=X&ved=2ahUKEwjU5vKW_sTeAhUEZd8KHZWCDBQQ9QEwAHoECAgQBg

BAE Systems, a major player in the business list the c**ore capabilities of its flight management systems:**

- Active inceptor systems (AIS)
- Actuator control electronics
- Autonomous controls
- Autopilot controls
- Fly-by-wire (FBW) control systems
- Ground collision avoidance systems

- Optionally manned flight control systems
- Prognostics and health management
- Rate and acceleration sensors
- Remote electronic units
- Rudder and yaw control
- Secondary/slats and flaps (high lift) flight controls and monitoring
- Spoiler control electronics and monitoring
- Stabilizer control and monitoring
- Vehicle management systems
- **BAE Systems**
    - https://www.baesystems.com/en-us/product/flight-control-systems?gclid=Cj0KCQiA2o_fBRC8ARIsAIOyQ-nyyhfpr1TQTzWO6rwWt6aMXlg8iNBKGCqe_Zwd0KnKZBMjwRzjdrUaAkCCEALw_wcB
    -

Self-driving vehicles, going from routine to something unthought of
Cruise control systems in cars have been around for decades and operate successfully, with cars getting more and more computerized.

Onto self-driving vehicles. In industrial applications large mining companies such as Rio Tinto and BHP Billiton are using fleet of driverless trucks to haul billions of tons of raw materials in part of Australia where temperature can rise above 45 degrees Celsius by using GPS, radar and laser sensors for navigation. These trucks are supervised by humans hundreds of miles away. In these situations no passengers are involved, the journeys are not carried out on public highways and in case of accident or malfunctions these corporations bear all the liabilities.

Driver less cars on the roads are absolutely fascinating, It is estimated that by 2025 driverless technology will grow to more than $900 billion worldwide yet the case of driver-less cars the situation is more complex. Potentially safer, they suffer no lapse of attention and do not get tired. The technology is based on radar sensors, video cameras, light detection and ranging sensors, Ultrasonic sensors and a main computer scanning all this information and controlling the steering, acceleration and breaking of the car via actuators.

It is a well-established fact that algorithms are already sophisticated and increasing so and will be able to deal with all the possible scenarios involved while driving a car. However here we look at some basics. Any driver knows that intuition, anticipation and courtesy constitute an important part of driving. Some challenging scenarios a driver-less car will have to cope with regards to impulsive human drivers, cyclists and pedestrians:

- Overcrowded roads: At peak time everybody is rushing to get to work on time in the morning and to get home in the evening. In these situations human drivers are stressed and take risks.
- Joining the motorway during a busy at time, looking for a suitable gap without running out of road. Sometimes a gap is made by a courteous driver who slows down or speeds up or changes lane depending on the traffic situation. But there can be instances where it is not possible to create a gap without putting the other vehicles in danger.
- Similarly, the driverless car must be able to create a gap to allow drivers to join the motorway before they run out of road space.
- Cars arriving at a roundabout or junctions where there is no clear right of way and each signalling their intention by their indicator lights. Resolution is normally obtained by eye contact and courtesy.
- Challenging weather conditions, flooding, rains, snow, and fog.
- Moving out of the way of emergency services where the audible warning is heard well before visual contact is made.
- Failure of critical sensors or dirty sensors registering wrong information.
- Coping with narrow, winding roads and sharp bends.
- Cars moving close to each other at high speed on multiple lanes winding motorways and winding rural roads.
- Anticipating a pedestrian using a crossing
- Anticipating and adjusting the speed at the approach of traffic lights taking all surrounding traffic into account
- A vehicle approaching the driverless car head on
-

The following considerations are also relevant:

- New legislations will be required for the apportionment of liabilities in accidents.
- The facility to override the automatic system in emergencies where people's lives are at risk.

- Road sensors and transmitters to warn driverless cars of hazards well ahead.
- A system of road beacons may also be useful to keep driverless cars in lane.
- Sensors are critical to road safety, therefore a system of self-diagnostics and failure detection and warning should be in place.

https://www.bofaml.com/en-us/content/future-of-mobility/driverless-cars-benefits-future-and-market.html?cm_mmc=GBAM-Integrated-_-Google-PS-_-driverless_cars-_-NB_Future_Mobility_-_Exact_Driverless_Vehicles&gclid=Cj0KCQiA2o_fBRC8ARIsAIOyQ-lh6XLta8V_xk7grQPaLzC3a18OEUlhE7mJj1nFMfus2XJgXNz-MDcaAhd6EALw_wcB

Other uses and perhaps abuses
https://www.telegraph.co.uk/technology/2018/11/07/brothels-could-move-self-driving-cars-academics-predict/

Concluding thought: a note of caution
Automated systems do make life easier for humans and are generally cost effective. However, due care has to be taken to use them. Of course, before being put to us, they are subjected to extensive testing. However, things could go wrong and often there is a human factor, in particular the need for adequate training in the handling of complex systems. One could refer to the case of the airliner flying from Brazil to France and taking a nose dive in the Atlantic killing all those on board; the story is that after all the procedures for take-off, reaching cruising altitude, the Captain went on break leaving the command to the pilot who may not have been adequately trained who all of a sudden was faced with a situation; he apparently fumbled and the plane went to a nose dive to the ocean. The recent incident right out of Djakarta airport may be another case in point.

Appendix 2.1
The Federal Aviation Administration (FAA) has called on all airlines to follow Boeing’s advice after Lion Air Flight 610 crashed into the Java Sea last month.
In a statement, the FAA said that it would soon issue an airworthiness directive that will compel all airlines to follow an Operations Manual Bulletin Boeing announced on Tuesday, according to Bloomberg, which obtained a copy of the statement. The agency added that it’s called on other aviation organizations around the world to do the same in their territories.

On Tuesday, Boeing said that it released an Operations Manual Bulletin (OMB) to airlines on how to address problems when an angle of attack, or AOA, sensor provides erroneous readings. The OMB acts as a guide of sorts for pilots and informs them on how they should respond when something goes awry.

The Lion Air Flight 610 crashed into the Java Sea last month, killing 189 people. The flight was set to carry passengers from Bali to Jakarta on the new Boeing 737 Max 8. However, soon after takeoff, the jetliner entered into a nosedive at a speed of 600 miles per hour.

While the investigation is ongoing, it's believed that the plane reported a problem with its AOA sensor, which measures the risk of a stall. In those cases, the plane's nose is automatically pointed down to reduce chances of stalling. If something goes wrong in the sensor and it registers a false positive, it's possible for a plane to enter into a nosedive, similar to what happened on the Lion Air flight.

It's unclear what's in the Boeing OMB and how it might address the AOA issue. Boeing did not immediately respond to a *Fortune* request for comment.

http://fortune.com/2018/11/07/faa-boeing-737-plane-crash/