EUKA
enabling the drone industry

2. Summary

EUKA
enabling the drone industry

1.1. Impact of digitalisation and robotisation within the labour market

- Commercial services sector in particular will feel the effects of digitalisation most strongly
  => only 7% of jobs show a high likelihood of digitalisation
    - As for industry, the question is whether further automation in production will gain pace in our region, given falling margins.
    - Construction: will digitalisation have a major impact on job?
        - The chance is small.
        - Construction is not a high-tech sector where developments in digitalisation are decisive. But jobs will be subject to major changes.
        - Digitising production in the construction sector requires an adaptation of the legal framework.
        - Only 30% of contractors are aware of digital technologies, and only 5% use them
        - Primarily larger contractor organisations are actively engaged with technological developments
- Impact on career mobility not clear => Unclear if more flexible and agile contracts will become the norm
- With Digitalisation and Robotisation, the main focus is on jobs that will disappear, but statistics have pointed to an increase in jobs in recent years
    - The reason why disappearing jobs are mostly is in the news is because they are easier to see
        - Job disappearances happen suddenly, while new job creation mostly happens at smaller companies and over a longer time.
        - There is more continuuity to job creation compared to job disappearances
    - Various other studies assume that digitalisation will make entire jobs disappear rather than, as is actually the case, that it will only take over certain tasks/activities rather than entire jobs. There is more evidence of symbiosis or complementarity than job destruction.
    - Adoption and the success factor of artificial intelligence will be a decisive factor when it comes to automating the routine jobs of higher-skilled people
    - The expectations of people are also important! Just because something can be automated doesn't mean it will be successful.
- Dual effect (big need for labour flexibility, while on the other hand specific knowledge & competencies are required)
- Access to digital platforms makes it easy to be self-employed
- Globalisation and digitalisation will put additional pressure on the broad segment of average-skilled workers
- But digitalisation may also add pressure to highly skilled workers, if digital solutions manage to solve complex questions

- The speed of technological evolution is making people nervous => One reason is that many citizens feel they are the new illiterates and cannot grasp the opportunities and risks of digitalisation.
- Complementarity is therefore actually an inhibiting effect of technological evolution
- Other inhibitory effects:
    - Technical limitations such as: Complexity, Financial (the cost of maintenance is also sometimes obstacle), Legal, Social-ethical
    - Reorienting workers
    - Risk of offshoring may fall by incorporating partial automation (wage cost becomes less important)
    - Economic growth forecasts => still not known what impact digitalisation will have here.
- One potential effect is that growing digitalisation makes the working population more productive, and this can lead to a general fall in prices, which can lead to more job creation by increasing demand for services and products
- Schooling in the future will primarily focus on making people more productive, along with robotics
- Longevity of qualifications and competencies will be curtailed by the digital transformation
    - Organisations also have an ever-gorwing responsibility for training workers
    - A diploma will lose value faster
- The digital transformation and associated speed of innovation reinforce the process whereby organisations will be forced to be even more agile, with flat, non-hierarchical structures, able to radically innovate and with an eye for incremental improvement
- The evolution within the labour market due to digitalisation, specifically for drones
    - Direct jobs: around 100,000:
        - Primarily among pilots, maintenance technicians and insurance.
    - Indirect jobs: around 250,000 to 400,000 by 2050 (representing between €25 billion and €45 billion)
        - Software and hardware
        - Electronics and engines
    - Being a drone pilot will not be a 'job in itself' to any significant extent in the long-term.
        - The job of drone pilot will in many cases be combined with existing areas of expertise.
        - For example, surveyors who will also learn to take their measurements with drones, and therefore also go through drone pilot (operator) training as well
    - Job creation (from p. 33)
        - Agriculture:

        - here, drones will primarily be seen as a service, due to limited availability of resources within the sector
    - Public & safety:
        - Here, the role of drone operator (from pilot to ...) will mainly be combined with existing roles/functions.
        - Specific training will ensure upskilling. It will also lead to job creation and growth
    - Delivery & e-comm:
        - drones will mostly first be adopted in difficult-to-reach places => only a small amount of deliveries => expected to be performed by manual pilots.
        - The existing workforce within the sector is broad enough to develop these additional competencies.
    - Mobility & transport:
        - The growth of the airline industry will demand more and more pilots. The gradual adoption of drone technology will mean that pilots will be gradually retrained to become drone pilots.
    - Energy & Inspection:
        - Around 100,000 jobs are expected here in the long-term, by introducing drones into the business model

1.2. Sector research

- **General:**
    - Inspecting industrial infrastructure
    - Monitoring and protection of pipelines, electricity lines, etc.
    - Mapping & surveying
    - Analysing crops within agriculture
    - Transport of medical equipment
    - Supply of real-time data
- **Agriculture**
    - Demand for food will double by 2050 compared to today =>
        - Creates a challenge to achieve more efficiency and productivity improvements in agriculture
        - Need for "greener" method of farming
    - A total of 150,000 drones are expected by 2035, and 145,000 by 2050
    - These drones will fall under the category of additional robotics in agriculture

- Business cases: Precision agriculture
    - Long range surveying (= remote sensing)
        - **125,000 drones** BVLOS by 2035 for surveying and mapping
        - Applicable for all type of agriculture (agri, livestock, fish, etc.)
        - Focus on detection based on sensors
        - Expected adoption by around 75,000 farms, who will own or lease the drones
        - A further 50,000 drones for other purposes
    - Long range, light payload spraying & seeding
        - **25,000 drones** for spraying/seeding by 2035
        - Due to the need for moving payloads, multicopters will be the main focus here
        - BVLOS is important for these applications
        - Regulations will have to be adapted as current EU legislation does not allow aerial spraying

- **Energy**
    - The business case here is primarily focused on reducing accidents and personal risks and increasing speed.
        - Electricity lines are ideal for being inspected by drones, since it can be done much **safer, faster and** cheaper than helicopters, or workers climbing up pylons.
    - Drones are **already used** in the oil and gas industry for **offshore** inspections of infrastructure
    - In the long term, it will be explored whether these drones can be managed and controlled remotely, and around **10,000 drones** would be deployed by 2035 to this end
    - **Clear EU-wide regulation** regarding BVLOS is important in this regard
    - Business cases
        - Local site inspection
            - VLOS, low altitude
            - Remote-controlled drones are expected to eventually replace local inspection teams
            - It is expected that 10,000 drones will inspect the various sites (same number of sites)
        - Long range utility inspection
            - BVLOS, low altitude & medium altitude (up to 3km)

        - For inspecting, e.g. high-voltage cables to replace manned flights (which are very expensive) or workers climbing up pylons (which is very risky)
        - Drones with sensors can also be used to detect gas and/or other leaks.
        - Around 1,000 drones would be needed for the support of around 8 million km of cabling, if each drone can inspect around 250km per day, 200 days per year.
        - Nevertheless, automated processing of data is important here for cost/benefit
    - Wind production drone
        - Tethered drones would be used at higher altitudes (about 450m) to catch faster winds and generate energy in this way
        - Around 5,000 tethered drones by 2035

- **Construction**
    - Equipped with cameras that take standard or thermographic images
    - They will be able to calculate the 3D coordinates of millions of points of a terrain in a short space of time
    - Advantages
        - Speed and accuracy
        - Only have to be on site once for a measurement
        - Track progress easily
        - Make visual (quotations)
    - Particularly interesting for roadworks and earthmoving work.
    - Will be able to detect heat losses and fly over large areas of solar panels to check which are no longer functioning
    - Visual inspection of hard-to-reach building parts
    - Legislation still currently restricts uses of drones for moving things
- **Public safety & security**
    - In the first instance, deployment for additional support for emergency calls and first aid will be looked at
        - **Real-time images and data help gain** better insight in a cost-effective way and make it possible to better target and direct team responses
        - Police and fire departments will primarily use **smaller low-altitude drones**, **usually in-vehicle drones** (drones that fit inside a vehicle). Ultimately (and depending on BVLOS legislation and technology for long flights) it would be possible to operate and store drones more centrally)

        - The expectation is demand for around **150,000 drones** => however, this will need to be looked at in the context of budgetary savings how many will be actually taken up
    - Other government agencies could maybe use an additional **50,000 drones** by 2050
    - Around **100** drones are expected to patrol the EU's external borders, and at the same time will be used to conduct environmental assessments
    - 3 types of missions
        - Stationary surveying by multicopters piloted by VLOS control (in-vehicle models)
        - Long range surveying (for the future)
        - Higher altitude surveying
    - In addition to the technological and **legislative framework, procurement decisions are also an important factor** which will be decisive for how quickly Drone technology will be adopted here. This is due to the trade-off between investment in new technology and resources (drones) and existing purchases from established channels
- **E-comm & delivery**
    - Delivering packages
        - It is estimated that this business case will be perfectly profitable provided 1 pilot can monitor/control multiple drones at the same time.
        - A key factor is legislative framework regarding BVLOS
        - Around 10% of the 7 billion EU packages are eligible
        - The main focus is on parcels **under 2.5 kg** (about 60% of all parcels)
        - Faster delivery and access to more remote and densely populated locations
        - Primarily for consumer and small business packages
            - Pharma, DIY, food, clothes, electronics, etc.
        - Around **70,000 drones** for 200,000,000 packages in EU by 2035
            - By 2050, around 100,000 drones
        - Note: last-mile delivery with drones would **not** be profitable
        - Optimistic scenarios suggest that a few retailers with sufficient scale could eliminate any delivery middlemen
        - Business case depends on
            - Accessibility of delivery address
            - Distance from sender
            - Impact of alternatives
    - Bulk cargo transport

        - By 2050, there would be 500 EU cargo craft
        - These would be fully converted to being ground-based controlled by 2050.
        - From 2030, first unmanned cargo flights
    - Logistics sector in general
        - Drones in the **logistics sector are only really interesting if they can fly autonomously** and remain under control.
- **Transport and mobility**
    - Unmanned aviation for civilian purposes still needs technological and legislative developments. Public acceptance also still has a long way to go
    - It is expected that the first fully autonomous cars will be on the road by 2025, the evolution in these vehicles will also set the pace for aviation (especially public acceptance)
    - Around 10,000 unmanned aircraft are expected to be flying by 2050, with the first ones emerging about 10 years after self-driving cars.
    - For railways, the estimate is a few hundred drones for inspection purposes. In the short term, few if any business cases are expected here
- **Media**
    - Primarily for film and photography
    - The expectation is around 30,000 drones (smaller drones) to operate at low altitude VLOS
    - Sports, entertainment, regional news from the approximately 11,000 EU channels
- **Telecommunications**
    - Primarily drones for routine inspections of towers (case quite similar to the energy market)
    - It is expected that around 3,000 drones will inspect 450,000 towers a year (if each drone can fly 200 days a year)
    - Additionally, this sector could also provide services in communication with high altitude drones.
- **Mining & construction**
    - Civil surveying and site management
    - Additional needs in terms of data processing of large data flows (data capture by drones)
    - Business model of around €10,000 per drone per year
    - For mining, around 7,000 drones are expected in the short term, for around 20,000 mines
    - For construction sites, the estimate is around 35,000 drones operating within densely populated areas
        - The legislative framework will be decisive for adoption here

- **Insurance**
    - Primarily for inspection purposes
    - 3,000 to 4,000 drones investigating around 1.75 million claims
- **Real estate**
    - Capture aerial views
    - An expected 15,000 drones
- **Research**
    - Focus on longer-range drones
    - BVLOS essential!!
    - Research that is not possible now
    - No details on the expectations, the estimate is that fewer drones will be needed here, possibly combined with long-range drones guarding borders (multi-purpose)
- **Government & commercial (p. 28)**
    - Significant uncertainty regarding future.
    - Vicious circle situation => three elements that affect each other and will determine how quickly drone scenarios will be adopted or rolled out
        - Legislative framework BVLOS flights over populated & unpopulated areas
        - Robustness of the technology
        - Social acceptance
    - Under conservative assumptions, we still assume 100,000 drones by 2035. **=> still major growth**
    - If public acceptance is good then the expectation is up to a million drones

1.3. Drones => inhibiting factors

- Regulation
- Safety and efficiency, together with public acceptance, are challenges that require a concerted approach and will largely determine the success of adoption
    - In the US, we see that as civilian drone use rises, restraint within governments and regulators also rises
    - Primarily engaged in the technological field with 'identifying the drone'
- No BVLOS
- Additional technological evolutions in the area of:
    - Big data analytics (e.g., for predictive maintenance services, agriculture & research purposes)
    - Components and systems for drive trains & batteries

    - Navigation
    - ATM software
- 5 - 10 years needed to catch up in the most critical **areas**
- Conservative attitude of existing business leaders within standard value-added industries
- Complexity and speed
- Focus on preserving margin
- Guidance framework

1.4. Evolution of the drones market abroad

- USA
    - The market for commercial and civilian drones will grow at a compound annual growth rate (CAGR) of 19% between 2015 and 2020, compared with 5% growth on the military side, according to BI Intelligence, Business Insider's premium research service.
    - 29,000 commercial drone pilots have been certified as of December 2016
    - 420,000 commercial drone pilots will be licensed by 2021
    - DroneDeploy users have generated more than $150,000,000 in economic value to the industry over 10 million acres mapped
    - Rates
        - $145/hour => photo
        - $168/hour => mapping

1.5. Technological developments

- The next generation of drones will be "SMART DRONES"
    - totally autonomous Drones, delivering data in real time
    - Smart sensors will control and monitor flight
    - built-in safeguards, networked together to enable coordination, collaboration and real time data delivery
    - technology that allows them to hook into the cloud-based UTM system
- Used in the following:
    - **Batteries** will get better
        - Enable Drones to fly for hours instead of minutes.

- **Cameras** will be an intricate part of Smart Drones
    - Cameras will not only be used for aerial photography, the feedback to on-board computers will be used for orientation, navigation and recognition to implement obstacle avoidance.
- **Software** will enable Drones to analyse their surroundings
    - Rather than use on-board systems that increase weight and demand more battery power, Computer Vision Software will allow you to stream video back to an object recognition server. This will enable Drones to analyse terrain and act according to certain sets of pre-defined instructions.
    - These software algorithms that control flight are being re-written by a fanatical community of DIY open source contributors.
    - DJI also introduced an SDK (software development kit) for its Inspire 1 and Phantom 3 drones. The system is meant to allow developers to build applications for those devices.
- **Sensors** to detect and avoid obstacles
    - biggest hurdle for Drone technology to clear in order to gain FAA approval for commercial use, is development of systems to prevent them from crashing into people or property, each other and even more important, into manned aircraft.
    - key challenge in developing such a “sense-and-avoid” system has been developing technology that can reliably detect the presence – and the course – of other aircraft and obstacles in real-time and to engineer it into a package small enough and light enough for quadcopter drones.

ESF INVESTEERT IN JOUW TOEKOMST
Europese Unie
Vlaanderen is werk