



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Emerging Technologies and Future Trends - Report 2

Collaborative Technologies

Name:	Greg Rees
Student number:	1905774
Programme:	MSc Applied Computing
Module:	Emerging Technologies and Future Trends
Date submitted:	25 th May 2020

Contents

Abstract	1
1. Introduction	1
2. Collaborative technologies.....	2
3. Benefits and limitations of collaborative technologies	5
3.1 Benefits	5
3.2 Limitations.....	5
4. Future developments in collaborative technologies	6
5. Limitations influencing the future of collaborative technologies	8
6. Conclusion.....	9
References	10

Abstract

Developments in technology such as the Internet of Things and cloud computing have enabled the growth of collaborative tools and technologies, which in turn have brought about changes in the ways that individuals and organisations conduct their business processes and operations.

This report explores the concept of collaborative technologies, the different tools used to facilitate it, and the ways in which these tools can be used by organisations to enhance their operations.

It was found that there are a number of benefits and limitations to an organisation from using collaborative technologies. However, these are very general and do not necessarily apply to all organisations. A key issue in deciding which technologies to adopt involves the business leaders being fully aware of how their businesses operate at all levels and also from them having a full and detailed understanding of how the new technology works and what impact they will have on the business processes.

There are a number of potential future developments in this field as technology advances and evolves. However, there are also a number of limitations which could influence the further evolution of this technology and some of these are also identified and explained, such as those concerning security and privacy issues.

1. Introduction

According to [TechRadar](#) [1], there are an estimated 4 million people working remotely in the United Kingdom who are using some form of collaborative technology to fulfil their work duties.

2020 has so far proven to be a pivotal moment in the usage of this technology, as the ongoing coronavirus pandemic has forced a number of businesses in the United Kingdom to reshape the way that they operate and shift a large proportion of their employees to conduct their normal job activities online. It is suggested that there will be a cultural shift as a result of current events and the proportion of people working remotely, and subsequently working collaboratively using technology, will increase in the future as businesses seek to reduce costs and streamline their operations [2].

This report aims to explain the concept of collaborative technologies and the different methods used to facilitate it. Examples of collaborative technologies will be explained, and their relative benefits and limitations will be outlined. Finally, there will be a discussion about the future of this technology and what developments could be expected in the future, as well as any challenges and limitations that may need to be addressed.

Commented [GD1]: Is this a reliable ref? Did deeper

2. Collaborative technologies

Collaborative technology is described by ConsoleTech [3] as tools and systems that are combined together in order to better facilitate group work, either in a defined place of work or remotely. This is supported by Correia [4], who goes on to explain that collaborative technology allows for communication between multiple people and enables them to work together towards shared goals whilst promoting and enhancing mutual respect, building trust and allowing for the acceptance of different perspectives.

According to Kittle [5], the origins of collaborative technologies can be traced back to the early 2000's when tools such as video conferencing were in their infancy and starting to become more prevalent. Initially, the technology was not available to the wider market and was limited mainly to organisations that wanted to experiment with more immersive environments for their workforce. However, the early versions of these collaborative tools were not always regarded as 'enterprise-class' and therefore not seen as reliable or powerful enough to be deployed on a large scale [5].

Gradually, as more tools were developed and released to the wider market, such as instant messaging, there was a surge in demand for more peer to peer interaction between individual users in a number of different settings. As the technology and tools became more sophisticated and powerful, they were adopted by a growing number of organisations to enhance their existing ways of working.

According to De Vreede et al. [6], the massive growth of the Internet and advancements in technology such as connectivity and network bandwidth have helped to provide a solid foundation and backbone to enable this growth.

It is also suggested that a key driver in the uptake of these new ways of working is the development of internet connected smart phones, tablets, and other connected devices, which allow users to communicate with others more effectively and in ways that do not require them to be in a fixed location [6]. The interconnection of devices in this manner can also be referred to as the Internet of Things (IoT).

However, Yin [7] points out that the Internet of Things is no longer just about connecting devices together but is now becoming ever more important in creating a more intelligent automated world. Yin [7] also puts forward the notion that the Internet of Things has now evolved and is slowly becoming the 'Internet of Everything (IoE)' which adds another dimension to the Internet of Things concept by identifying connections between people, data, processes, in addition to connection between 'things'.

Developments in cloud computing in the last decade have also facilitated the uptake of collaborative technologies, with computing services such as databases, networking, servers, storage, and analytics

Commented [GD2]: No need – so close to previous

able to be provided over the Internet. This has allowed organisations to tap into only the services that they require, resulting in reduced costs and enabling greater efficiency [8]. As business processes adapt, organisations are able to scale their use of these services to suit their needs.

Carnegie Mellon University [9] outline that the many different tools that exist to support collaboration can assist an organisation in the following ways:

- Facilitating synchronous and asynchronous text, voice, and video communication by allowing employees to work together either in real time or at different times
- Helping to manage project management tasks and allowing the organisation to work towards defined goals in set timescales
- Supporting groups in their creation of new ideas by allowing them to work asynchronously or in real time
- Allowing consensus to be built by group discussions and communication
- Managing resources by helping to simplify and streamline their use, such as storage spaces or version control of shared documents

Examples of collaborative technologies are outlined by Olson & Olson [10], who put forward that they can be classified into three sub-categories:

- **Communication tools** – which can include things such as email, texting, online chat, voice and video conferencing, blogs, forums, and wikis
- **Collaboration tools** – which can include shared calendars, meeting support tools, visual displays, workflow, and resource scheduling
- **Information repositories** – which can include the system architecture, the network, large scale computation and human computation

Elements from these three categories have been absorbed into proprietary collaboration platforms which can be found in many organisations today such as Microsoft Teams and G-Suite from Google.

Bayrak [11] identifies that there are a number of specialised uses of collaborative technologies that are already found in many organisations in areas that include:

- **Supply chain management** – which deals with managing the movement of goods and services throughout the organisation
- **Project management** – overseeing and managing the work of a team of people to meet a specified objective and success criteria
- **Distance learning** – enabling studying remotely and interacting with others via email, forums, and video conferencing
- **Human resources management** – managing the people of an organisation
- **Corporate learning and training** – developing employees to become better at their jobs and ensuring compliance with legal requirements
- **Research and development** – investments in technology to allow an organisation to acquire new knowledge to develop new goods or services
- **Sales and marketing** – enabling the organisation to promote and sell their goods and services
- **Customer relationship management** – using technology to help an organisation to build and develop customer relationships whilst ensuring that processes are streamlined to maximise sales and profits

Bayrak [11] goes on to state that collaborative technologies have now evolved so significantly that they are becoming a core feature of the enterprise infrastructure for many organisations, as the physical confines of the traditional workplace have been removed. However, the decision whether to adopt these new methods of working must be assessed against the perceived risks, perceived benefits, and the general attitude within the organisation towards information systems.

The concept of multi-team membership is introduced by Bertolotti et al [12] as a factor in determining the effectiveness of collaborative technologies. Multi-team membership, or MTM, is the term used to describe an employee whose job role spans a number of different teams across an organisation. In this situation, there is a suggestion that the dynamics of multi-team membership could have an effect on the operation of the single teams in which an employee could be involved with. Being a member of multiple teams could have an effect on the level of performance of an employee as they may be expected to engage in many different online environments at the same time. As they divide their time between teams, it is suggested that their work could potentially become more fragmented and not be as thorough as it otherwise could be.

3. Benefits and limitations of collaborative technologies

Collaborative technologies have certainly made a huge impact and gained serious momentum and sustained growth. Bodell [13] has outlined a number of advantages and disadvantages of collaborative technologies as a productivity tool in organisations:

3.1 Benefits

- **Flexibility** – as employees are able to work at times that best suit them, savings can be made in work schedules as greater flexibility is achieved
- **Cost efficiencies** – overheads in many areas can potentially be reduced as there may be fewer infrastructure needs and a reduction in ongoing maintenance costs
- **Greater participation** - a wider range of contributors could be asked to participate in tasks which could allow for a greater number of ideas and opinions and delivering faster solutions
- **Scaling** – the scaling of systems used to work collaboratively can be implemented relatively quickly, and projects can grow as required because there is no need to depend on traditional software
- **Security** - features provided by cloud platform providers, such as encryption of data, can be utilised to ensure the protection of sensitive information

3.2 Limitations

- **Accessibility** - agreements must be reached with the workforce for achieving a suitable work-life balance, as the concept of being 'always-on' suggests that employees are always accessible and available for work
- **Lack of clarity** – the quality of personal contact could suffer, and the subsequent quality of communications could be affected. The potential of miscommunication of ideas could also increase as it may be harder to explain them without having real time interaction
- **Feature overload** - the prospect of having so many features available may prove to be too much of a distraction and detract from the features that are actually required. Only the features and tools that are essential should be included to prevent distractions
- **Management of technology** - additional roles may need to be created and the resulting costs could add a financial burden to an organisation as there may need to be a dedicated administrator to ensure the collaboration tools were working correctly
- **Security** - the management of security features is outsourced to cloud platform providers. The security of data and information would depend on their security policies and may not be sufficient to guarantee adequate protection

- **Determining success** - it may be difficult to assess the impact of these new ways of working over a short period of time and this must be factored in when determining how successful they have been
- **Efficiency factors** – when employees are presented with excessive options it could result in the working environment becoming less efficient and organised. Swift answers to questions may be harder to attain in this situation [14].

4. Future developments in collaborative technologies

Newman [15] suggests that organisations that fully embrace the various collaborative technologies that are available to them can improve their productivity by between 20 and 30 percent. This will be very attractive as many consumers now expect an advanced user experience and fast response times. Newman [15] goes on to suggest that there are some key trends in collaborative technologies that organisations should make themselves aware of:

- **API's and integration** – APIs are sets of pre written commands, functions and protocols that are used to enable interaction between software systems within an organisation and external systems [16]. As organisations begin to use many different applications collaboratively it would be wise for them to take advantage of APIs that are already available for them to work seamlessly. The availability of APIs could be a deciding factor in choosing which applications to use in the future so there will be a focus on making sure they are available to system administrators.
- **Virtual and Augmented Reality** – virtual reality will allow employees of organisations to engage with each other in new and dynamic ways. One such example would be a virtual boardroom meeting where robots could be used to mimic human beings. The eye movements and body language of the employee could be replicated by the robot allowing employees to feel more connected to their meetings. Augmented reality, on the other hand, would enable users to be even more immersed in their surroundings. For example, employees may be able to be in the office without actually needing to attend a physical workplace. Using AR technology could allow them to visualise their office workspace from their own homes by layering digital information and objects over the real world.

Commented [GD3]: Interesting point – you could expand on this

Commented [GD4]:

- **Smart Virtual Personal Assistants (SVPAs)** – the use of SVPA's can assist in the raising of productivity and collaboration between employees. SVPA's can be used to assist in meeting scheduling, reminding about tasks, and note taking. They could also be implemented to automatically scan emails for important information and producing an action plan, or creating a daily meeting schedule from an online calendar [15].
- **Data analytics** – the shift to using online collaborative technologies will generate ever more data and analytics which will need to be stored and analysed. The capturing and recording of large datasets were originally a problem, however these processes have now been largely automated. The problem now exists within analysing the data and finding patterns and conclusions. The use of big data analytical tools will enable managers to monitor how employees are engaging with their collaborative tools. By tracking their workflows, managers will be able to establish which businesses processes are effective and eliminate those that make them less efficient [17].

5. Limitations influencing the future of collaborative technologies

Having such a wide variety of collaborative tools available presents a new set of challenges for managers in organisations.

Firstly, whilst the introduction of technology to encourage employees to work together can bring about positive benefits, Monitor Deloitte [18] identify that it can be hard to know where to begin implementing changes. This is where managers must ensure that they have a clear understanding of how the business operates. It is vitally important that the needs of all users that are involved remains central to any new strategy that is considered. This way there is less of a focus on specific tools that might be available and more of a focus on what is needed to get the job done [18].

Managers will also need to make decisions on where to focus their financial resources, as it is likely that any introduction of new technology will require some sort of financial investment. Smith [19] explains that the introduction of communication and collaboration tools will be worthless to an organisation unless they support and enhance the existing ways of working. The overriding goal for any investment in this type of technology will be whether it helps employees to get their work done more effectively. Smith [19] adds that there is a direct correlation between the employee and customer experience and that the development of any digital strategy in the workplace must factor in the experience of all stakeholders for it to be truly successful.

Forbes [20] puts forward the concept of organisations being too quick to introduce collaborative technologies and tools, and not truly understanding their purpose or the value they can add to the organisation. This can result in greater sharing of valuable data, information, and intellectual property with outside providers. This rush to introduce technology, without fully understanding all of the associated implications, can create dependencies and vulnerabilities which can threaten the security and integrity of an organisation. Forbes [20] goes on to identify that some organisations will take a far more cautious approach and limit the sharing of data and information in order to maintain control.

Even with localised security measures implemented within a workplace, there is a suggestion that these are no longer sufficient as more connected devices means that data is more often 'in-motion', meaning that it travels outside an organisations firewalls and boundaries. This needs to be taken into consideration when deciding which tools and techniques are to be installed and appropriate measures taken to ensure the protection of data and information [21].

Commented [GD5]: You could have included a brief overview of a case study highlighting the benefits and limitations you have identified.

6. Conclusion

It is clear that there have been huge developments in collaborative technologies and tools over the last decade. Advancements in the concept of cloud computing and the Internet of Things (IoT) have aided this development and provided a backbone for their evolution.

There are many benefits that can come from adopting these collaborative technologies in different business areas such as in supply chain management, human resources management and in research and development areas. However, managers and those responsible for making strategic decisions in an organisation will need to ensure they are very clear in what they are aiming to achieve by investing in and adopting these technologies. Simply investing in them and having the technology available to the workforce will not automatically improve business processes and equally, will not be sufficient if the workforce is not clear on how they should be used or how they can conduct their job duties more efficiently.

The adoption of new technology will also bring about other issues that will need to be considered, such as those concerning security and accessibility. A full and detailed assessment of all of the potential risks to the organisation should be considered by managers and there should also be input from the workforce who could be directly affected.

There are some interesting developments on the horizon involving collaborative technologies which could add new scope to their use and entice more business leaders to adopt them. Developments such as those in virtual/augmented reality, API's, Smart Virtual Personal Assistants, and data analytics are bringing about exciting changes to the traditional ways of a workforce collaborating and working together. However, as stated previously, it is the responsibility of business leaders to know how their businesses work, to thoroughly investigate new technologies that are being considered for use, and to examine how any new technology would fit with existing business processes.

References

- [1] TechRadar, "The future of collaborative technology," 2019. [Online]. Available: <https://www.techradar.com/uk/news/the-future-of-collaborative-technology>. [Accessed 30 April 2020].
- [2] Grigorian.T, "Will working from home remain a perk or become a right?," 6 May 2020. [Online]. Available: <https://www.personneltoday.com/hr/working-from-home-after-coronavirus-right/>. [Accessed 10 May 2020].
- [3] Consolidated Technologies Inc, "Types of Collaboration Technology," 18 March 2019. [Online]. Available: <https://consoltech.com/blog/types-of-collaboration-technology/>. [Accessed 2 May 2020].
- [4] Correia.A-P, The SAGE Encyclopedia of Educational Technology: Collaborative Communication Tools and Technologies, London: SAGE Publications, 2015.
- [5] Kittle.J, "Perspectives: The Evolution and Impact of Collaboration Technologies," CISCO, 2 October 2014. [Online]. Available: <https://blogs.cisco.com/perspectives/the-evolution-and-impact-of-collaboration-technologies>. [Accessed 10 May 2020].
- [6] D. Vreede.G, Antunes.A, Vassileva.J, Gerosa.M and Wu.K, "Collaboration technology in teams and organizations: Introduction to the special issue," *Information Systems Frontiers*, vol. 18, pp. 1-6, 2016.
- [7] Yin.D, "The Internet of Things (IoT) and Collaboration," RingCentral, 9 August 2019. [Online]. Available: <https://www.ringcentral.co.uk/blog/the-internet-of-things-iot-and-collaboration/#ring-uk>. [Accessed 2 May 2020].
- [8] Microsoft Azure, "What is cloud computing?," [Online]. Available: <https://azure.microsoft.com/en-gb/overview/what-is-cloud-computing/>. [Accessed 2 May 2020].
- [9] Carnegie Mellon University, "Collaboration Tools," Eberly Center, [Online]. Available: <https://www.cmu.edu/teaching/technology/collaborationtools.html>. [Accessed 2 May 2020].
- [10] Olson.J and Olson.G, "Collaboration Technologies and Their Use," *University of California Irvine*.
- [11] Bayrak.T, "Identifying collaborative technology impact areas," *Technology in Society*, vol. 42, no. 1, pp. 93-103, 2015.
- [12] Bertolotti.F, Mattarelli.E, Vignoli.M and Maria.D, "Exploring the relationship between multiple team membership and team performance: The role of social networks and collaborative technology," *Research Policy*, vol. 44, no. 1, pp. 911-924, 2015.

- [13] Bodell.K, "Collaboration," [Online]. Available: <https://www.cloudbakers.com/blog/pros-and-cons-of-real-time-cloud-collaboration>. [Accessed 2 May 2020].
- [14] Cunningham.E, "How to Overcome Challenges When Deploying New Collaboration Technologies," BizTech, 24 July 2019. [Online]. Available: <https://biztechmagazine.com/article/2019/07/how-overcome-challenges-when-deploying-new-collaboration-technologies>. [Accessed 2 May 2020].
- [15] Newman.D, "3 Technology Trends Driving Adoption Of Collaboration Tools," Forbes, 17 May 2018. [Online]. Available: <https://www.forbes.com/sites/danielnewman/2018/05/17/3-technology-trends-driving-adoption-of-collaboration-tools/#65bf6bd0156a>. [Accessed 2 May 2020].
- [16] Tech Terms, "API," [Online]. Available: <https://techterms.com/definition/api>. [Accessed 3 May 2020].
- [17] Khvoynitskaya.S, "The future of big data: 5 predictions from experts for 2020-2025," iTransition, 30 January 2020. [Online]. Available: <https://www.itransition.com/blog/the-future-of-big-data>. [Accessed 2 May 2020].
- [18] Monitor Deloitte, "Harnessing Collaborative Technologies - Helping Funders Work Together Better," Foundation Center.
- [19] Smith.D, "Choosing the right collaboration technology for workplace connectivity," CIO, 1 March 2019. [Online]. Available: <https://www.cio.com/article/3346221/choosing-the-right-collaboration-technology-for-workplace-connectivity.html>. [Accessed 3 May 2020].
- [20] Forbes, "The Opportunities And Risks Of Technology-Driven Collaboration," Forbes Insights, <https://www.forbes.com/sites/insights-cliffordchance/2020/02/25/the-opportunities-and-risks-of-technology-driven-collaboration/#23a7306f4104>, 2020.
- [21] Nucleus Cyber, "5 Data Security Challenges to Modern Collaboration," Nucleus Cyber, 2018.

MARKING CRITERIA AND STUDENT FEEDBACK

This section details the assessment criteria. The *extent* to which these are demonstrated by you determines your mark. The marks available for each criterion are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Common Assessment Criteria Applied (Assignment 1)	Marks available	Marks awarded
1. Engagement with Literature Skills Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions.		
You have engaged with relevant and credible sources. The appropriated referencing format used. Perhaps an over-reliance on web refs.	20	12
2. Knowledge and Understanding Skills Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.		
Appropriate definitions used. Good but elsewhere one or two ideas/terms would benefit from a brief introduction or definition.	20	15
3. Cognitive and Intellectual Skills Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence		
A good topic to investigate. You clearly identify the pros/cons. Good. However, at times you should explain why something is advantageous or a limitation. For this topic, it would have been good to have included at least a critical review/ case study of how it is being used by an example company or industry or how it is being explore in an experimental way. An attempt at organising the technologies and their uses into a structured, cohesive whole would have helped, or outlining a framework or formalised suggestions to guide scenario specific implementations (did you find many papers offering frameworks/guidelines?). Diagrams could be use as well to visualise these ideas. It is good, you have link the IoT discussion with 5G and security issues. No new discussion should be in your conclusion, you should be summarising the salient/important points from the report. (Grade mark: 70.00%)	50	33
4. Practical Application Skills Deployment of methods, materials, tools and techniques; application of concepts; formulation of innovative and creative solutions to solve problems.		
5. Transferable Skills for Life and Professional Practice Attributes in professional practice: individual and collaborative working; deployment of appropriate media; presentation and organisation.		
Your report is in general well written and structured. Conclusion is fine.	10	7

Assignment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		67%
	Up to four weeks late		
	First Attempt?		

