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Connectivity & Collaboration is about Inclusion

John McGrory
Technological University Dublin, john.mcgrory@tudublin.ie

Aitor Arribas Velasco
Dublin Institute of Technology, aitor.arribasvelasco@tudublin.ie

Matteo Zalio
Technological University Dublin, matteo.zallio@tudublin.ie

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McGrory, John
Dublin Institute of Technology
TPOT Group, Grangegorman
Dublin 1, Ireland
john.mcgrory@dit.ie

Arribas Velasco, Aitor
Dublin Institute of Technolog
TPOT Group, Grangegorman
Dublin 1, Ireland
aitor.arribasvelasco@mydit.ie

Zallio, Matteo
Dublin Institute of Technology
TPOT Group, Grangegorman
Dublin 1, Ireland
matte.zallio@dit.ie

IoT technology offers an opportunity to reuse components and share data between project stakeholders, thereby reducing the cost of duplication and improve the prospect of collaboration. We read in papers that this stakeholder "collaborated" with this partner or that person. However, what is frequently touted as collaboration is in fact a lead stakeholder leveraging (typically) domain knowledge from partners. A true collective collaborative solution should be a better solution, than cases where one stakeholder leads the process, leveraging (bolting-on) other stakeholder intellectual components. This paper will demonstrate a framework and technique to act as an educational tool to help non-technical stakeholders interact more effectively with technical groups and provide a framework for rich collaborative exchanges to occur. The framework itself is also used as a tool for demonstrating and teaching collaborative systems. Finally, the litmus test is, to describe your domain using infographics, predominantly void of excessive text and isolating jargon, then see if other groups can comprehend it. Now you will have started the process of collaboration.

Keywords: Collaboration, internet of things (IoT), education, idea sharing, form, fit and function.

1. INTRODUCTION

Taking a holistic overview of any media presented at conferences, seminars or in journals, we find there are three underpinning threads of commonality:

(a) The topic of interest (usually embodied within the title e.g. Human Computer Interaction)

(b) Pattern of formatting/style through which results and findings are presented (editorial consistency).

(c) Patterns of subtext such as phrasing, ontology, syntax, semantic, pragmatic and context layers, which are interweaved within the text.

Overtime, the media becomes developed and refined with the domain expert gaining a comfort in the familiarity of the material. However, to an outside observer, it can be somewhat daunting and challenging to navigate and engage effectively with the material, akin, in social circles, to an outsider trying to break into a group of individuals that has already solidified. The challenge to breaking into a group is to identify the language, kinship, subtext, humour, creating awareness and categorising characteristics of different individuals or sub-groups, as well as being familiar with the material presented. Some of the greatest advances have happened when cross-pollination between domains has occurred (Johnson, 2010).

When we refer to a "truly collaborative" solution, we refer to a solution that should be a far better fit for purpose and improved (akin to an alloy), when compared to a stakeholder led solution, where one stakeholder leads the work with their viewpoint taking precedence and leverages (or bolts on) components by others to provide a solution. Or more simply stated the solution is "bigger and better than the sum of the parts" (Johnson, 2010). In a true collaborative process, each member of the team can add their dimensional view of the material. For example, in Figure 1 a mock-up collaborative network environment is portrayed where (1) refers to the stakeholder with their own expert and personal knowledge, inner cycle of execution and a domain specific library of terms, (2) recognises shared information needed to aid in the collaboration (i.e. noticeboard/whiteboard), (3) indicates a white pages to be able to contact any individual to ask for help, (4) indicates a yellow pages concept were services can be searched linking to individuals that can help, finally (5) relates to time and its importance in relation to the timeliness of the collaborative process.

Of course, collaborative processes are not limited to teams meeting around a table; successful environments have been developed electronically, as illustrated in Figure 2 (Corkhill, 2003).

Proceedings of….

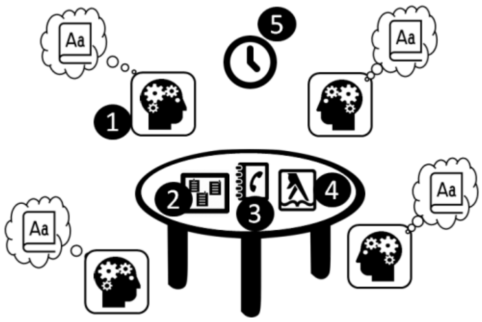

Figure 1: *Collaboration among human experts.*

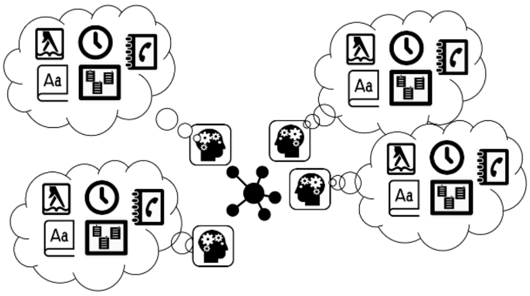

Figure 2: *Remote Networked Collaboration*

Some groups of non-technical stakeholders envision a “magic or mystery” surrounding a process cycle operation and its description. Although non-technical groups may use a notional cycle regularly for their own domain, they may not have decomposed their cycle into its fundamental components and structure. Alternatively, they might not know how to explain it to other groups outside their domain. This lack of detailed process awareness contributes to stakeholder isolation, as the syntax, semantic and pragmatic expression of a process cycle and its description can be discipline or technology focused, rather than collaborative team focused. Also, if the non-technical group cannot clearly describe (articulate) it, and be truly passionate about expressing their ideas, other groups will find it challenging to collaborate with them too. Hence, the easier option is to bolt-on or leverage other stakeholder components to provide an inclusive solution of sorts.

The Internet of Things (IoT) offers an opportunity to share data collection resources between many stakeholders in a system in an agile way. Consider for example a simple Passive Infrared (PIR) sensor used to detect a person. An intruder alarm system uses a PIR to detect a person entering a space. An office heating system uses a PIR to detect a person in a space, turning off heat when no person is present. A fire alarm system uses a PIR to detect a person to enable speedy evacuation sweeping. A lighting system uses a PIR to detect a person in a space, turning off lights when no person is present. In each system the same fundamental operation of person detection is repeated, but each stakeholder (security, hvac, fire, and lighting) decided to install their own components at a cost to the client. This modest example highlights that if the system stakeholder is not aware of the needs of others to monitor the exact same entity, they will never share or collaborate activities. There is a distinct lack of clarity on subtext patterns, such as those highlighted earlier; phrasing, ontology, syntax, semantic, pragmatic and context layers, which are interweaved within the text of the individual system specifications. It is so interweaved that it’s easier to ignore it and go it alone on an “island of isolation” design. When this is scaled up many times the amount of duplication could be enormous. But how can we bridge these islands and incubate the collaborative process?

2. SET THE FOUNDATION

From a teaching of a team collaboration perspective a number of lessons can be learnt from the human learning paradigms cross-pollinated with human collaboration. Figure 3 illustrates a simple flow process cycle and includes universal infographics to portray information using unsophisticated symbolic icons that are easy to understand by non-technical and technical members alike. Of course, it is best to begin with a blank page and then begin to add each aspect by drawing the system. Taking a human factors perspective, stronger and accurate memory retention and engagement is best achieved by:

(a) Starting with a blank page and evolving the idea, (Khan, 2018).

(b) Hand drawing connections or flow using tangible facts in the information, that are relevant to the individual, as it requires a person’s attention and critical thinking, (Hopper, 2015).

(c) Continuity of the creativity idea flow, without being limited by format, layout or editing (Hopper, 2015) (Benimoff, 1993).

(d) Including the candidates and encouraging them to participate by describing how they have interpreted the information (Worthington & Bodie, 2017).

(e) Using self-explanatory symbols (triggering an automatic mental identification response). This is a different part of the brain function, allowing the brain focus on another more complex learning task at the same time), (Benimoff, 1993).

Our image in Figure 3 begins with label (1) space needing heating control. (2) Measurement of the temperature using a simple glass thermometer. (3) Eye encoding the information of the level of the liquid in the thermometer against the markings for delivery to the brain. The brain processes that information (4). (5) Decoding of the solution of the room control to the manual opening of the valve and finally (6) valve operated to modify the temperature. Finally, in the centre of the image a directional arrow indicates the direction of the flow. It all appears simple enough.

In Figure 4(a)(b)(c), the process level of detail is enlarged building on the knowledge of the first generic Process Cycle in Figure 3. Reinforcing the simple cycle perception each time, but building extra knowledge (changes to function and fit components) to the image, whist keeping the same form. Form, Fit and Function are three terms used to identify and describe characteristics of a system under development or modification (Norman, 1988).

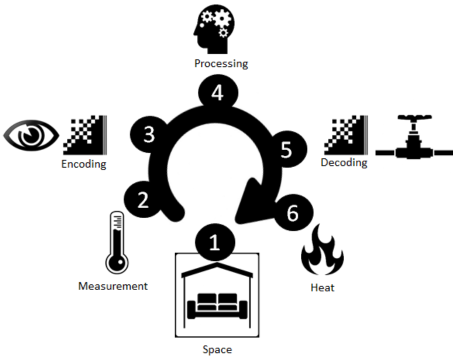

Figure 3: *Process Cycle*

Figure 4, shows an evolving iterative design process which distinguishes three similar communication formats, all trying to achieve a similar goal of communicating process data. (a) Process Cycle Electrical and (b) Process Cycle Variable (analogue), (c) Process Cycle Ethernet. Figure 4 (a) (1) is still the room of interest. (2) icon for a thermostat with the image of a thermometer beside it. (3) illustrates the encoding icon, but enhanced with the inclusion of an electrical symbol. Then between (3) and (4) are electrical wire icons. The brain of the system is replaced by a microchip icon illustrated at (4). (5) decoding of the information back into the real-world system, finally ending at (6) where the heat is controlled going to the room. Figure 4(b) retains a similar look and feel of the process and infographics, but develops the information at each point in the Figure by including variable sensing (0-10vDC), and Figure 4(c) goes further where the prime signal is based on Ethernet messages. In this case, based on Normans criteria the Function is the same but Form and Fit are altered (Norman, 1988).

Figure 5 retains the process cycle, but measurements now progress to originate at different types of sensors, each encoded into a text message sent over the Ethernet. Now the contrasting notion introduces context and accurate description. In this example observing the finer dashed line from the camera measurement unit (2) to the processing unit (4) via route (4a) it shows people counting. However, the processing decision is complicated when a measurement of people and temperature is required to be combined via route (4b). Is the temperature and people encoding of a similar/compatible data type (i.e. apples and apples or apples and oranges). This simplified graphical representation illustrates *syntax*, *semantic*, *pragmatic* and *context* issues without resorting to technical jargon, which would act to exclude non-technical stakeholders, where the key question is "are they compatible data types?".

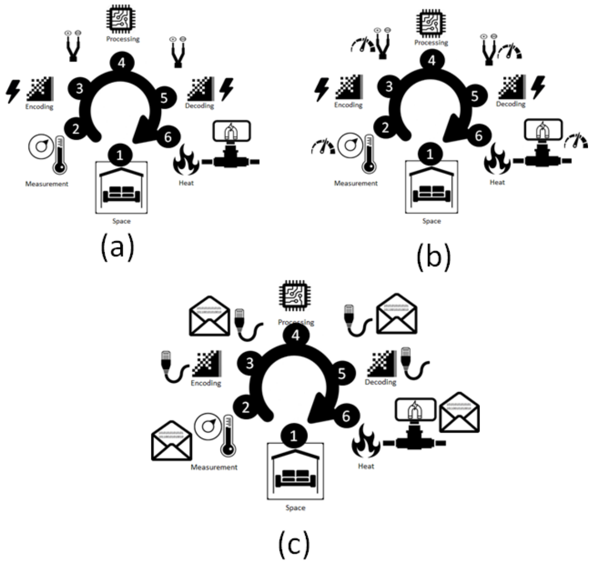

Figure 4: *(a) Process Cycle Electrical and (b) Process Cycle Variable (analogue), (c) Process Cycle Ethernet*

In Figure 6 earth replaces space (1), indicating that perhaps a number of actuator outputs would need to be combined to have effective control, rather than just room heating. The processing unit (4) produces this control output decision. If the process is simple as illustrated in (4a) connected to the motor (6) using the fine dashed line, that is a relatively straightforward outcome. However, the processing issue is complicated when different variables and sensor measurements are used and/or more than one direct acting output can be used to realise the same outcome on the space (1). This is a perfect application base for IoT technology and systems.

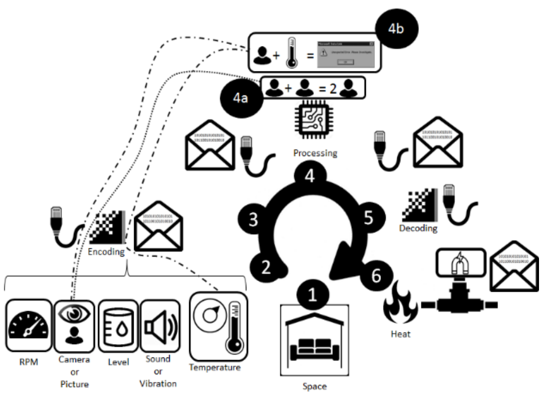

Figure 5: *Process Cycle Sensor Measurement*

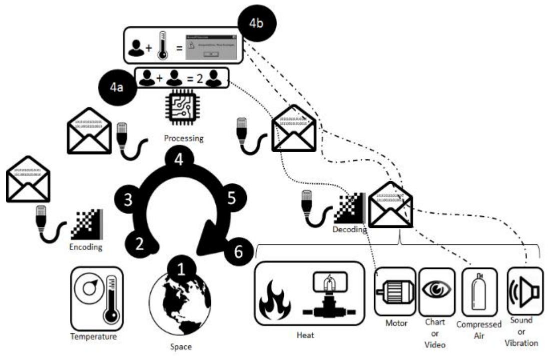

Figure 6: *Process Cycle Actuator Output*

2. HIGHLIGHT THE FUNDENMENTAL ISSUE

So far we set the scene for our non-technical and technical stakeholders to focus and unite on the fundamental issue, the inner communications between control entities Figure 6 (4a) and (4b). Figure 7, shows the merging of the measurement inputs (2) and the actuator outputs (6). Of course, they add a layer of complexity to the image, but as each component was included in the design evolution, and was explained in detail, the discussion can continue with a greater degree of clarity. The fundamental aspect of Figure 7 is the inclusion of three different types of processing and in particular the requirement for various interactions between the three processing components at (4.1), (4.2) and (4.3). Simply digitising the data (creating digital bits/bytes) versions of analogue/physical things as shown in Figure 4 is not enough. Digitalization is different: it enables and improves business operations, functions, processes and activities, by leveraging digital technologies into an actionable, understanding of knowledge. In essence, these three processing components have the opportunity to provide distributed digitalization functionality, but only if the collaborative framework discussed previously is present. Therefore, the paradigm shift changes from sensors or actuators *connected* to controllers via IoT, to more critically the interaction *between* controlling entities via IoT.

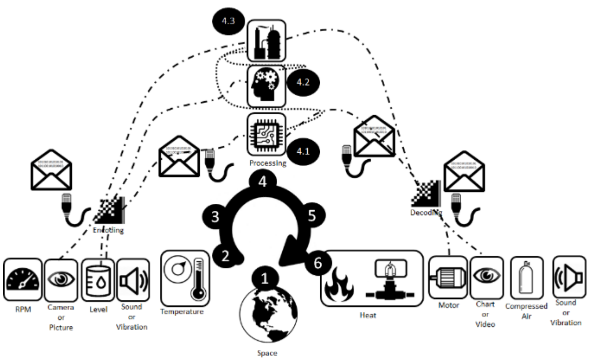

Figure 7: Process Cycle Enhanced

Figure 8 shows a modified version of Figure 2, with the actors changed: a process (1) a controller (2) and human (3). The process could be an office, department, or set of business rules, and the controller could be an individual or industrial computer, all communicating over the IoT. Scaling the system further to highlight the complexity, Figure 9, illustrates many similar entities interacting simultaneously and collaborating within a system.

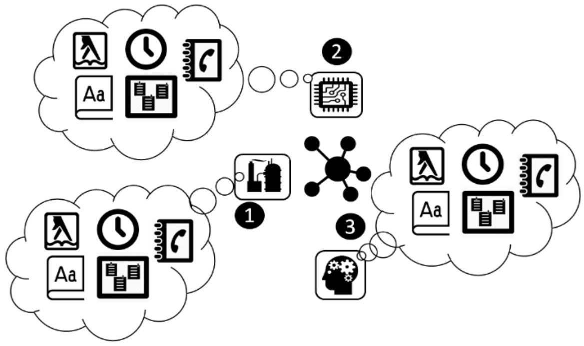

Figure 8: *Network*

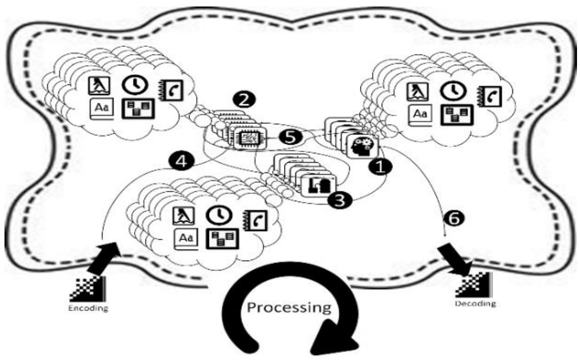

Figure 9: *Scaled up network*

3. CONCLUSION

Education of communication skills are the cornerstone of the collaborative process. In this paper, we have highlighted some of these skills, such as including infographics where possible, evolve our ideas from a blank canvas and eliminate non-domain specific jargon or encoding, otherwise we will alienate our collaborative teams. The enterprise now should focus on engaging as many stakeholders as possible, non-technical stakeholders and domain specialists from all demographics, disciplines and lifestyles in the development process, with an emphasis on true collaboration. It is essential we identify information to be presented on our shared collaborative whiteboard/noticeboard, what data is to be collected (type, context, timing) and how it will be manipulated (is there domain specific algebra or reasoning) and how are control outputs activity delivered. Finally, true collaboration does not require stakeholders to have a complete comprehension of another's stakeholders' field, just awareness of factors that influence their domain.

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