What makes for a rewarding iGEM experience?

With only a few days left before the dreaded wiki-freeze, it's time for some reflection on the year gone by. Was the countless of hours of stress and struggle worthwhile?

The answer was a unanimous yes from team iGEM Lund. For some of us, this was the second time participating in the iGEM competition and our answer was in stark contrast to that of last year. So what enabled us to have a more fulfilling experience?

Just that – experience and perspective. A greater understanding of what ought to be accomplished, in what manner it should be accomplished and in particular, *why* it should be accomplished.

Undeniably, iGEM is in many ways a life-changing experience. Undergraduate research prospects are scarce in Sweden. If we are lucky enough to participate in actual research before graduate school, the degree of autonomy, the scope of the project and the opportunities for collaboration is very limited. iGEM provides a holistic playground for aspiring scientists to fully explore their interests and solidify their understanding of professional research. By promoting a strong moral code and the classic academic values of cooperation, commitment, integrity, creativity through autonomy, effort and excellence, it also bestows a sense of purpose amidst an era of denialism. But to allow for the continuation of such an agenda in a world of increasing contention and distrust, it is of paramount importance to minimize any elements that might detract participants from taking full advantage of it.

That served as the basis for a large part of our Human Practices endeavors. We begun the year by sitting down and discussed what makes for a satisfying iGEM experience and what deters from it. Our conclusion was the following: An understanding of,

- How the different aspects of the competition tie together.
- Appropriate time allocation between the different aspects of the competition. In particular with regards to the laboratory work.
- Team composition, dynamic, motivation and conflict management.
- Appropriate occupational stress management.
- An appropriate level of expectation and ambition.
- Prioritization.
- How to assess performance on an individual as well as group basis.
- Synthetic biology and the practical techniques involved in genetic engineering.

An analysis of the common denominator between these factors generated the following verdict: For a successful iGEM experience, knowledge of the project group organizational architecture and proper management is necessary. Looking at previous human practices efforts, an effort to elucidate the organizational form, strategic management tools and developing methods of assessing performance has largely been ignored. Thus, we decided to initiate the project of outlining the iGEM project group

The Successful iGEM Project

What constitutes a successful project? Perhaps even more perplexing is the question, what constitutes success, in and of itself? While the answer may seem clear cut, we are of the opinion that it is not. It depends on the nature of the relationship between the project and the external world. Those are, that of the Individual, the Group and Society. This creates the potential for contradictions and conflict if any of the Judger[1] does not share the same view of success as the remaining two.

As a first order of business, we must set out to define *success*. This poses a great number of challenges. It is not just a matter of semantics as success can hold both qualitative and quantitative definitions. However, the following statements hold true.

- Attribution of success to some object necessitates attribution of not-success to other. The attribution is made on the basis of shared category.

In that sense, it is always related to external factors. First and foremost, it relates to the nature of the Judger, as success is an inherently subjective experience. Second, it relates to that which implies its non-failure – its contrasting elements. Third, it relates to the framework used to interpret it. It is necessarily contingent on its context. Thus, quantitative analysis is only possible if the framework allows it.

This treatment is important as it shows that the word success is ambiguous and that assignment as some property is not relevant unless contextualized.

We will therefore define project success in relation to the individual team member, to the iGEM competition, to affiliated institution and finally, to society. In addition, we will make a series of arguments as to why project success is warranted, if not necessary, on all instances and how it can be achieved. Our hope is that this will serve as motivation to strive toward excellence.

We propose the following set of definitions.

- In the context of an individual team member, we propose that a successful project is one of exemplary job satisfaction.
- In the context of iGEM, a successful project is defined as outlined in the Judge's handbook.
- In the context of affiliated institution, we propose that a successful project is one that embodies the values and agenda of that institution.
- In context of society, we propose that a successful project is one that promotes sustainable progress (Hall and Lamont, 2009).

[1] We capitalize Judge for sake of differentiating between the iGEM competion judges.

We now define the *ideal* project as one that embodies all four aspects of project success. The rationale behind the choice of the four different instances is, simply, that they are the parties that principally affected the outcome of the project. They all, to different extent, set some of the system characteristics. In economic term, this can be expressed as every team creating a *service* (the project) with intention of producing some *utility* to its *clients* (the four instances). This perspective is purposeful in so far as reflects why it is important to be successful.

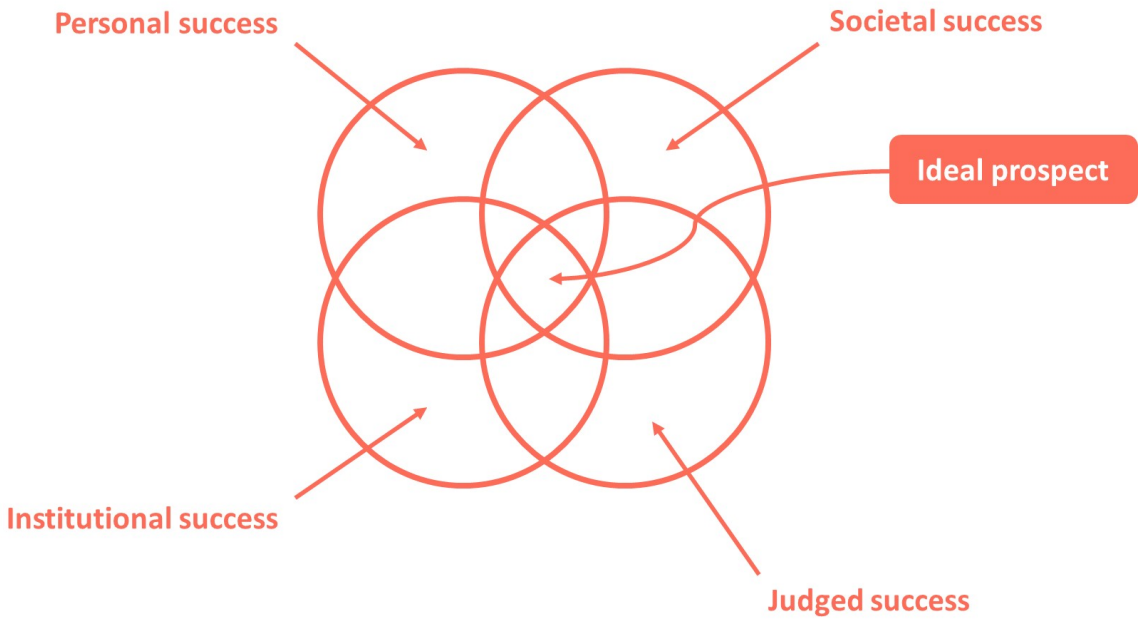


Figure 1: The ideal project

Why should the ideal project be achieved?

From the provided perspective, this can be accomplished by satisfying some needs of each client. The main two clients are the individual team members and iGEM through its judges, as they hold the majority of power in assessing achievement. However, before discussing how success can contribute to utility in each client, the following assertion has to be made.

Success is necessary by virtue of *competition.* Every project is part of the iGEM competition, a fact that carries some an important implication on how each project should be viewed. The competition can be conceptualized by analyzing its objective through its definition.
Three important aspects should be considered in any description.

- As rivalry (Ely, 1901)
- As a selection mechanism (Ely, 1901).
- Freedom to participate (Stigler, 1957)

A competition is a voluntary exercise in rivalry on the basis of assessment. Thus, by participating in the iGEM competition, the teams sign a social contract that allow the judges to evaluate their performance as compared to their competitors and that the judges set the benchmark. In addition, utility is derived from successful competition.

Thus, we argue that participation is the iGEM competition implies that each team should strive to successful. In addition to understanding *what* a successful project might entail through analysis as to the *purpose* of such a venture, we aim to derive some principles on *how* success should be obtained.

The conclusion from our analysis is, as will be made apparent, that performance is the key factor.

A successful project in the eyes of iGEM

iGEM is the main authority on assessing success. Therefore, it should be seen as the chief controlling mechanism in how a project should be constructed. Success is measured in reference to the Judge's handbook.

It makes the following assertions (Judge's handbook, 2018).

- The project should be novel and conducted by the students using a systematic methodology based on engineering and synthetic biology principles.
- The project should be well defined, cohesive and focus should lie on quality rather than quantity.
- The project should provide a foundation for future work through rigorous documentation and presentation.
- The project should integrate and disseminate knowledge from and for the benefit of society respectively.
- The project should be an *impressive* and *creative* endeavor to solve a specific problem.
- The project should incorporate all values stated by The IGEM Foundation.

The underlying theme is clearly *progress for the benefit of society through synthetic biology.* The extent to which this has been achieved is *measured* through the *excellence in performance* of the team. In addition, this has the benefit of promoting continuation of iGEM support of each team by funders and associated institutions, as it adds utility in the form of their brand recognition.

A successful project in the eyes of the individual

The perception of a project is subjective and is based on the sensation of utility or sense of *reward*. A project necessarily entail some work and generates a sense of reward from work is indicated by high *job satisfaction* and low *job dissatisfaction* (Herzber, 1976, Cano and Castillo). Extensive research has been conducted on what the indicators of job satisfaction are, how they relate to the work environment and how they manifest in the

individual (Locke, 1969; Lyubomirsky et al., 2005; Politis, 2006, Gällstedt, 2003). Different frameworks have been proposed on the basis of empiric investigations, with varying degree of success in explaining the psychological foundation. One such framework that has been successfully utilized in context of academic project, which reflects the nature of the iGEM competition, is the two-factor theory (Herzber, 1976, Cano and Castillo, 2004; Gazioglu and Tansel, 2006; Padilla-Velez, 1993). It describes job satisfaction as contingent determinants of satisfaction, motivators, and determinants of dissatisfaction, hygiene and includes the following.

- Motivators: achievement, recognition, work in and of itself, responsibility and advancement.
- Hygiene: policy and administration, supervision, salary, interpersonal relations and working conditions.

The theory states that if motivators are implemented, workers will experience job-satisfaction, whereas if hygiene conditions are removed, job-dissatisfaction is reduced. From this we can conclude that to experience project success, the individual need to perform well. This will facilitate obtainment of motivators and diminish the necessity of hygiene-conditions by display of functional autonomy.

A successful project in the eyes affiliated institutions

The iGEM competition requires mentoring and supervision of the team in the form of instructors. These are, as a general ruled, assigned faculty members of the associated collegiate. Thus, the project should also reflect the agenda and values of the collegiate. The motivation to support an iGEM team is that it will contribute to its public relations, as previously concluded. This is best measured by how much positive attention the team generates, as is a reflection of the degree of performance. In addition, good performance will serve to inspire and motivate excellence in other students. This will in return reflect on the status and as such the brand of the institution (Svinicki, 2005).

A successful project in the eyes of society

We will make a series of arguments based on the concept that activity that promotes sustainable progress contributes to the overall usefulness of the project.

- By virtue of contribution to synthetic biology
- By virtue of contribution to academia
- By virtue of youth empowerment

By virtue of contribution to synthetic biology

The iGEM foundation is an initiative to promote the advancement of synthetic biology, as indicated by its vision statement (Judge's handbook, 2018). For this to materialize, the iGEM competitors need to provide significant novel contributions.

By virtue of contribution to academia

The academia is the institution designed for the exploration and exploitation of knowledge for the greater good of mankind. However, there has been a transition in values and spirit in academia, to what has been called the 'Publish or Perish' paradigm following injections of entrepreneurial management strategies (N. A. Gillespie et al., 2001; Harzing, 2007).

This has severely affected the work of the academic staff. The golden age of the Enlightenment ideals governing the organizational identity of the institution – of absolute freedom and inquiry by the virtue of insight into that which benefits society, appears to be a thing of the past (Kruse, 2006; Delanty, 1998). The consequences have rippled throughout society. A clear rise in occupational stress and the impact on health has been noted and has been linked directly to increased performance demands and workload (Reda, 1996). There has been a significant decrease in quality of output research. Quantity has been used as the main performance indicator, forcing academics to pursue *me-too* research rather than focusing on development of new tools (Philpott, 2011; Kenny, 2017). Furthermore, development is contingent on autonomy, reducing the possibility creativity and thus novel insight (Philpott, 2011). The managerial paradigm seems to have undermined the very ethos of academia (Kruse, 2006; Delanty, 1998).

The iGEM competition initiative, in contrast, promotes novel research into science and engineering. Such opportunities, as indicated, are now rare, making it all the more import to perform well.

By virtue of youth empowerment

In an extensive treatment of youth participation in community-building activities and research, it was concluded that there exist significant bias toward the capabilities of students to participate in research successfully (Delgado, 2006). The consequences have been deemed dire. Youth do not feel that they are given sufficient opportunity to design the direction of society to aptly match their needs and beliefs, creating a sensation of disenfranchisement (Hansen, et al., 2003). iGEM competitors are given the power to change the course of science and thus society at large – one biobrick at the time. It is therefore paramount that they perform optimally. It will serve to show that youth does the opportunity to have an impact on society, serving as a source of inspiration to those who feel alienated. Arguably even more importantly, it will show people of authority that youth can indeed contribute successfully, which will increase the prospects of involving youth in future policy making.

Thus, we conclude that *good performance* lies at the intersection of success as according to society, science, the institution and the individual. Thus, it is a contingency for the ideal project. Enabling good performance in a project team can only be achieved if each team member realizes their full potential as individuals and as a group. This is contingent on solid strategy, a good work environment and the resources to do so. In other words, it is related to good *project management.*

Toward a theory of the iGEM project organization

Correct selection and application of management strategy is contingent on recognition of *what* needs manage. A comprehensive framework of analysis for such endeavors is provided by organizational theory and has successfully been utilized in the design of management strategies (Daft, 2010; Anheier, 2014). An organization is a social body interacting with its environment through some processes designed in accordance with an overarching mission. Organizational theory attempts to explain the complex social phenomena that arise within and at the boundary between such entities (Daft, 2010). It emerged as a rigorous field of study in era of industrialization as a consequence of centralization of the means of production, specialization and introduction of large firms. The enterprise form remains as then focal point of contemporary research, but interest in non-traditional organization forms to better understand the contemporary economic climate (Starbuck, 2005).

The iGEM project organization[2] (TiP) as a social entity within the scope of organization theory poses an interesting case. However, to investigate the matter in any meaningful way, the critical dimensions of organizational design needs to be considered. Fundamentally, TiP is, as the name would indicate, a project-based organization (PBO). While many different conceptualizations of the PBO exist, the arguably simplest and most inclusive definition is that of *an organization that organizes most of its activities in projects and programs* (Miterev et al., 2017:1). We identified three key indicators as to why this holds true for TiP: by virtue of rhetoric used by iGEM organization, by the definition of the *student competition* as well as by the nature of its inherent characteristics.

- By virtue of rhetoric used by the iGEM. The 2018 Giant Jamboree Judge's handbook serves as the basis of TiP assessment proposed by the iGEM Foundation. *Project* is used to describe the sum of accomplishments within the different units of TiP (Judge's handbook, 2018).
- By the definition of the student competition. An engineering student competition has been defined as "Students obtain real-world design and problem-solving experience and see how their *projects* …", making a strong case for evaluating student competitions as project competitions (Goldberg, 2013).
- By the nature of its inherent characteristics. The Prince2 manual for project management defines the project as "A temporary organization that is needed to produce a unique and predefined outcome or result at a pre-specified time using predetermined resources" (Turley, 2010). This aligns well with the course of TiP. Competitors synthesize a project idea, acquire sufficient resources for its realization and attempt to execute it within the timeframe of the iGEM cycle.

The PBO has received a lot of attention in management research, as it has come to dominate project-oriented production across many industries and has established itself

[2] Henceforth we will refer to the entirety of engagement by an individual team as *The iGEM Project/Process organization* (TiP).

within both the public and third sector (Nightingale, 2011; Miterev et al., 2017:1-2; Sydow et al., 2004). Management scholars have suggested that the PBO require a new theory to identify relevant organizational design choices that accommodate the stark contrast in organizational architecture to that of traditional enterprises (Miterev et al., 2017:2; Sydow et al., 2004; Yoo et al., 2018; Galbraith, 1974). It has also implied that a theory is necessary to determine appropriate management strategy; in other words, recognizing novel *organizing procedures* necessities recognition of a novel organization (Gareis, 1991). Such procedures can only be determined by solving the four "universal" problems of organizing; task division, task allocation, reward provision and information provision (Puranam et al., 2004).

We noted some issues that might occur trying to resolve these problems throughout the TiP process.

- Task division: refers to the processes of developing a sound strategy to realize goals. In context of TiP, it necessitates a comprehensive understanding of the different elements of the competition and how they are interlocked prior to any synthesis of an overarching project methodology.
- Task allocation: reflects the process of matching work with appropriate competence. For example, through mandating specialization to optimize the process of achieving success. However, for success to materialize, as defined by the Judge's handbook, a wide range of skills is necessary; from an insight into the principles of synthetic biology, to research methodology, project management and administration, communication expertise, "big-picture" appreciation, knowledge acquisition and an "engineering" approach to problem-solving to name a few. Thus, it is not feasible to acquire such comprehensive competence within the time frame of iGEM, imposing demands on the recruitment-phase of the project.
- Reward provision: constitutes the strategy of maintaining motivation within a team. This represents one of the, if not the, main predicaments facing TiP project management. Project prosperity obligates great commitment, tenacity and dedication of each team member. The project is a voluntary engagement, which waives for traditional reward systems. Thus, it is up to the team to promote, and maintain motivation.
- Information provision: concerns the information that is necessary to execute and coordinate work. The necessity of having an established system in place for facilitating efficient work reveals another potential bottleneck. A wealth of knowledge is required to establish continued success throughout TiP. Nevertheless, the endeavor might still prove fruitless if no measures are taken to select the appropriate knowledge and implement it in according to contextual parameters. An overall operational strategy provides immense value in terms of efficient, but when detailing specific activity, structure and flow cannot just be applied as is but must be synthesized ad hoc. This process relies on extensive knowledge of both methodology and of related discipline to tailor correctly according to conditions.

This discussion highlights the importance of understanding the organization. The definitive aim of the organization is to realize its goals by employing its available resources in its given context. These differ between organizations and using processes designed for some prototypical organization can only guide strategy so far. For example, the context may change. To then maintain realization of its goals, one of two approaches can be conceived. Either the organization redefines itself every time some of its contingencies change to preserve the plan of action or it upholds its core and modifies its approach. Naturally, it is easier to adapt rather than rebuild.

An additional arguments as to the need of organization design needs to be noted. If an organization intends to implement new strategies and seek help in doing so, it has to communicate its intentions in an understandable manner. The theory of organization provides the means to do so.

The approach to adapt or *align* organizational elements to accommodate a changing environment is the processes of organizational design. It is generally accepted that strategy is the governing procedure in the design process (Galbraith, 2007; Miterev et al., 2017:2). Strategy is best understood as *the determination of the basic long-term goals of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals* (Chandler, 1962). Thus, it involves formulating the means (the sum of intended action on a given context) to an end.

Strategy is therefore the means by which an organization procures competitive advantage within the space of competing organizations (Mintzberg, 1994). Competitive advantage refers to the ability to offer clients greater *value*. From this viewpoint, the client of TiP is the iGEM Competition through its judges. Value assessment occurs on the basis of perceived value as inferred by the Judge's handbook

We will aim to synthesize a design of TiP with the intention of uncovering core principles governing the space of appropriate decisions. Many different holistic frameworks exist for such a purpose. All, however, emphasize the importance of coherence between different units in the organization.

Two such theories that are commonly referenced are that of the contingency theory and the theory of complementarity. Both are theories that stress the essentiality of internal cohesion. Contingency theory states that there is no best way to make a decision, as decision outcome is always contingent on the internal and external situation. The combination of all internal and external factors that might affect a decision reflects its inherent *complexity*. The more dimensions, the more combinations of possible interacting elements and so a higher degree of complexity. The idea of complementarity adds another dimension to complexity by analyzing how interrelated decisions may produce synergistic effect (Van de Ven et al., 2013; Kates and Galbraith, 2007). To make a simple complementarity analysis of TiP, Judge's evaluate the project on basis of cohesion, among other things. The total utility of a project in the eyes of a judge will be higher if assessed in its totality as compared to the total utility of individually assessed elements.

Any decision-making that occurs in an organization has to be evaluated in relation to how the organization might respond. The criterion that determines this response makes out the *organizational capability* and represents the set of unique factors that differentiate the organization (Kates and Galbraith, 2007). In other words, the competitive advantage of an organization is resolved by its capability.

We conclude the following from reviewing available literature. Both theories attempt to create a methodology to assess how some event might affect the outcome of certain decision-making within an organization given a particular organizational form. By virtue of such processes, the design dimension (and their interrelation) and certain events (input) has been mapped to degree of success in regards to the applied strategy.

This is simply the black-box modeling approach to determining strategy that everyone proficient in the field of synthetic biology should be familiar with. However, the trial-and-error basis of TiP might not be the best strategy to deduce strategic decisions, given the limited resources. Instead, we propose to draw from the wealth of available literature on the topic to guide the modeling process for us.

We will use the framework of the modified Star Model™ as the starting point to instruct the design process of TiP, as has been applied in the analysis of PBO design in the past (Miterev et al., 2017:1-2; Kates and Galbraith, 2007). The Star Model™ consists of five elements, arranged as nodes in a star-shape. Each node, or organizational element, represents a factor crucial in the process of adapting to some stimuli or put in other words, dictating organizational policy. They are the means of maintaining organizational capability. The five elements generally of concern are *Strategy, Structure, Process, Human resources and Culture*, connected by some edges that represent their interconnectedness (Miterev et al., 2017:1-2). It needs to be re-iterated that the set of elements and their interrelation is highly context-specific and should be evaluated in reference to the specific organizational form.

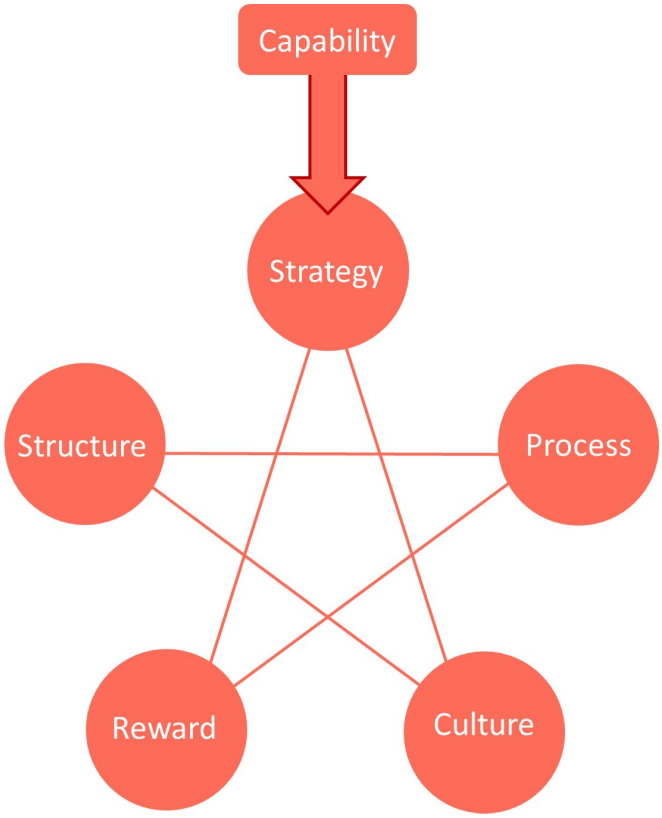


Figure 2: The Star Model

The first step in the process is of designing the organization should be defining the strategy. The strategy of the organization is the key to its success. It should outline the strategic priorities in achieving the goals of the organization.

The structure should delineate the hierarchy within the organization. All organizational structure encompasses *specialization, shape, power distribution* and *departmentalization*. In the project-based organization, these are formed around function. The idea of grouping together units by function is to promote relevant knowledge-transfer and thus optimize productivity and expertise. This does, however, introduce the issue of cross-structure communication.

Process is the systematic process of linking structures within the organization. It is a series of actives that facilitate knowledge-transfer to ensure cohesion. These include managerial processes, such as planning or standardization strategies, and work processes. The aim is to minimize inefficiency by clearly indicating what needs done and by whom. Two possible representations of flow can be conceived, lateral and vertical.

To properly align individual performance with the goals of the organization, incentive systems are put in place. It seeks to reward behavior that fits with the strategic objectives. The nature of the *reward* is either static or dynamic and is necessarily based on its

relation to structure. The incentive system design is a complex process, as the metric on which it should be evaluated is not clear.

The final consideration is the organizational *Human Resources* within the organization. It concerns the implementation of policies that fosters a mind-set adjusted to enable strategic decisions. It needs to be considered on all conceivable axis of the organization; inter-structurally, intra-structurally, organizationally and externally, as well as geographically and temporally. Thus, it is a highly dynamic process.

For sake of conceptual clarity, we will summarize the process as discussed above. An organizational design is a cohesive plan to adapt to change as it might occur in relation to the organization. For this to be possible, the organization needs to clearly define a strategy dependent on the its specific capabilities – the internal and external factors that make up its ability to adapt as compared to other organizations. After clearly defining its strategy, a blueprint of how the internal architecture of the organization will implement the strategy needs to be drawn. These include the structures, processes, incentives and culture.

These five elements and their interconnectedness needs to be defined to cope with changes as they come along. Thus, we will now attempt to analyze the situation from the perspective of TiP.

We will now construct TiP using the principles of the Star Model™ (Miterev et al., 2017:1-2; Kates and Galbraith, 2007). The aim of such an endeavor is to serve as a foundation in the process of organization design by future competing teams. We will give a comprehensive look at some key characteristics of TiP in an attempt to establish the relevant design dimensions. The question to answer is what gives TiP its dynamic capability.

As related to structure

The hierarchy is not well defined within most iGEM teams. A high degree of specialization is necessary due to the scope of the competition. Knowledge-transfer occurs horizontally between all members. Thus, there is no clear definition of management in the traditional sense of being the policy-implementing structure.

The degree of autonomy is interesting in the context of TiP. On the one hand, it is loosely embedded within two organizations; The iGEM Foundation and, if applicable, the associated institution. However, we will choose to use the position reinforced by literature, namely that the degree of autonomy is how often the project group has to report to parent organization(s) (Lampel and Jha, 2004). Thus, the team is autonomous in the sense of maintaining authority over TiP. However, both the institution and the iGEM Foundation facilitate assistance if necessary, in the form of mentorship.

As related to the organization type

Projects are inherently subjective to uncertainty, in so far as that every case represent a unique organizational architecture (Turner and Keegan, *loc cit*). This was implied in the earlier discussion of the organizational contingencies. They are also temporarily limited with a clear starting point and a clear end point, creating a sense of urgency. In addition, there is significant uncertainty in the project success. These characteristics match those of the TiP.

The purpose of competing is to successfully deliver a product as evaluated by the Judge's handbook. The nature of the innovative process can be summarized as universal design – with focus on project cohesion, cooperation, community and completeness. This aligns with the paradigm of Open Innovation, which suggests that the best solutions for a problem should be adopted by adopting both external and internal ideas (Mustaquim and Nyström, 2013).

As related to team

Work must be facilitated through incentives. This poses a great challenge to TiP, as work that requires intense effort is best rewarded by monetary incentives (Holmström, 1999). Reward must instead be derived by other means. Research indicates that volunteerism occur on account of work being perceived as important and reflects opportunity for growth. In particular, however, feedback was given as the main motivator (Rosén and Reinklou, 2013). A sensation of authenticity, that intrinsic values match those of the work environment, for an overall sensation of well-being is paramount. Research indicates that this is one of the most important aspects of occupational well-being (Ménard and Brunet, 2011).

For most students, iGEM represents their first foray into the realm of research within synthetic biology. Thus, knowledge-acquisition, idea-generation and insight into engineering principles are the most valuable, as the synthesis of these generates the possibility of realizing a project. Necessary knowledge may then be acquired through means of knowledge repository systems.

Cooperation lies at the heart of the iGEM competition. Many teams are eager to help each other in advancing aspects of TiP.

As related to resources

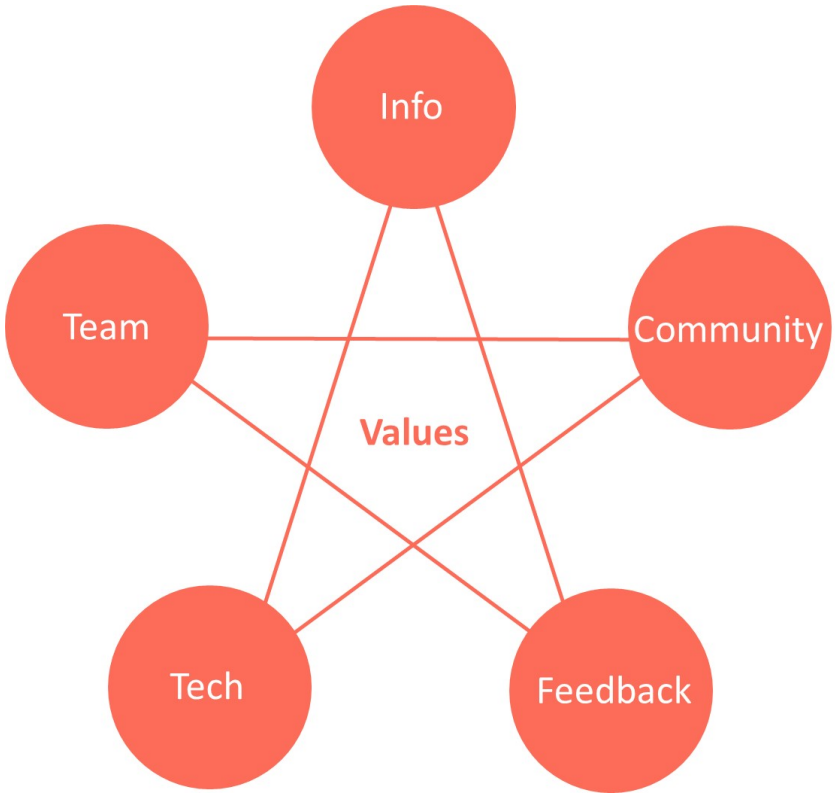
TiP is funded by means of acquiring external funding. In some cases, the affiliated institution is able to cover the cost, but many teams are required to look for funding through other means. However, both iGEM and its various sponsors offer free non-monetary resources or comprehensive discounts.

The iGEM competition is, at heart, an engineering competition. Thus, integration of technology is necessary to facilitate success.

We summarize it as follows.

- TiP is a highly autonomous flat projected-based organization.
- Collaboration and cooperation is essential for knowledge
- The institution and the iGEM community provide assistance.
- Reward is possible through intrinsic factors and feedback.
- Technology is necessery

From this we construct the following star model. The most important aspect is Team, representing the TiP specific team, Reward, representing motivation, Tech, representing technology, Info, representing knowledge acquisition and processes, and Community, representing the iGEM community and the institution, as the elements that facilitate adaptation capacity. Values are also highlighted, as they help shape the nature of interaction between the different elements.



From this entire discussion, we can draw some conclusions on team management.

- Autonomy is necessary for creativity. Thus, during ideation, which is contingent on creativity, phases of the project, the organizational structure should be kept flat.
- Feedback is one of the most important mechanisms of reward in a voluntary organization, such as TiP.
- Authenticity is of outmost importance. Thus, the values of the team needs to correspond to that of every singly team member.

For the sake of facilitating this, we have created exercise to facilitate finding common values for the organizing, inspiring creativity and on giving constructive feedback. They can be found at the end of this handbook.

Definitions:

Organization is a multi-agent system with goals.

Strategic planning is the process of determining the internal and external priorities and the plan of action, or **strategy**, to achieve **strategic goals** as reflected in the vision statement. Strategy implies a set of capabilities at which an organization must excel in order to achieve such goals (Mintzberg, 1994).

Values, vision and **mission** are the bedrock of the organization in so far as they serve as a benchmark in any decision-making process. Values are the set of beliefs held by the organization and reflects the philosophy that should be adopted in decision-making. The vision statement describes the aspirations of the organization. In contrast, the mission statement delineates what the organization does.

Project the temporary organization to which resources are assigned to do work to deliver beneficial change (Daft, 2010). This does, however, not properly reflect the inherent uniqueness. Thus, we will specify that the work entailed is *unique* work as opposed to routine work found in other organizations.

Organization(al) structure refers to the formal allocation of roles within the organization and mechanisms for integration and control of work activities (Daft, 2010).

Organization(al) form or **type** or **configuration** is the complete set of *recurring* relationships (technology, structure, products, goals, and personnel) between organizational members (Daft, 2010).

Organization(al) design refers to the methodology of aligning organizational structures with organizational roles. That is to say, a deliberate process of configuring structures, processes, reward systems, and people practices, the **design criteria**, **factors** or **variables**, to create an effective organization capable of achieving strategic goals (Daft, 2010).

The design dimensions are the sum of **internal factors**, organizational-specific (e.g. that of a PBO) contingencies and **external factors** that comprises the organization design (Kates and Galbraith, 2007).

Capabilities are set of unique and integrated combination of elements within the organization that provide competitive advantage (Kates and Galbraith, 2007).

Organization(al) architecture is a holistic framework explores the interface between organizational structures as well as its resources through analysis of both formal and informal structures (Silverman, 1997)

Formal structure of an organization constitutes the normative systems designed by management. It is de jure coordinating mechanism (Shtub and Karni, 2009).

Informal structure of an organization emerges organically, as opposed to the formal structure, as a social structure through repeated social exchange. (Shtub and Karni, 2009).

Vertical process flow is organized around internal hierarchy with a clearly defined direction, such as resource allocation (Kates and Galbraith, 2007).

Lateral process flow is constructed to enable cross-structure interaction, such as informal communication (Kates and Galbraith, 2007).

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Values Workshop

Defining personal and group values through storytelling

Perceived authenticity in the workplace has been discussed as a potential key factor in individual employee well-being (Brunet, 2011). Thus, to optimize the organizational performance, the sensation of authenticity needs to be nurtured. Studies suggest that the core component of authenticity is living an authentic life; that is to say, to be able to act according to the individual's own values and personal belief. Such opportunity has been related to a heightened sense of loyalty, group affiliation, engagement and role-identity (Ariza-Montez, 2017; William 1990).

Authenticity can be stimulated through shaping the core values of the organization according to those of the employees. Not only will this lead to a sensation of empowerment through self-actualization, but increased effort, involvement, mindfulness, motivation and creativity (William, 1990). The following section introduces a workshop iGEM teams can utilize to guide each member in defining their individual values followed by the group common values. The purpose is to help the team members find a common ground between their personal values and group values. Together with World Values Initiative, a student driven organization, and Value, a company working with the development of organizational values, we present to you the iGEM Values Workshop.

"For an organization to thrive and be successful, it is of great importance to align the individuals' values with the group's values."

iGEM Values Workshop

How often do we stop and think about our personal values? Have you ever actually sat down and tried to determine these values? We constantly act and behave according to our values. Most of this value-based decision making happens subconsciously, and one can argue that we never get the chance to stop and think consciously about our values.

Values act as guiding principles in everything we do. They provide us a code of conduct for our behaviors. Our values are acted out through our actions, words and thoughts. They determine, among many things, what we say yes or no to, our moral judgement and the commitment to our needs and goals in life.

It is important to realize that once a group is formed, a shared belief and value system starts to take shape. The formed organization becomes its own entity with values that permeate its ethical decision-making, internal and external communication and the established norms. The second part of the workshop guides the group to collaboratively create and articulate the iGEM team's values.

This workshop will serve as a tool in helping the team members map out their personal values and later, together with the entire team, define the group's values. This workshop employs storytelling accompanied by active listening to personalize and deepen the experience of the participants.

The workshop includes both a "check-in" and a "check-out". The reason for doing this is to gather information about what the participants are feeling prior to and after the workshop. Checking in allows each member in a group to be seen, heard and connected to the present moment. It promotes a focused commitment towards the workshop. The

participants get a general overview of the group's collective intentions. Checking out allows the participants to reflect upon what they gained from the workshop. It is also an opportunity for the facilitator to learn how the workshop could be improved to better suit the needs of the unique iGEM team.

Part 1 - Defining personal values

Time

- ~60 minutes

Preparations

- Printed copy of the values from Appendix
- Post-it notes or index cards
- Pens
- An open and relaxed space with a wall or whiteboard for attaching notes

Facilitator instructions

1. (1 min)
   Create a circle of trust by obliging the participants to keep whatever is said during the workshop within the group. All opinions and personal stories stay within in the circle and are only shared with good intention.

2. (3 min)
   Brief the participants on the instructions of the workshop.

3. (5 min)
   Do a check-in. Go around the group and give each participant two post-it notes each. Ask the participants to write:

a. One desired personal outcome from participating in the workshop
b. One way the workshop could contribute to the iGEM project.

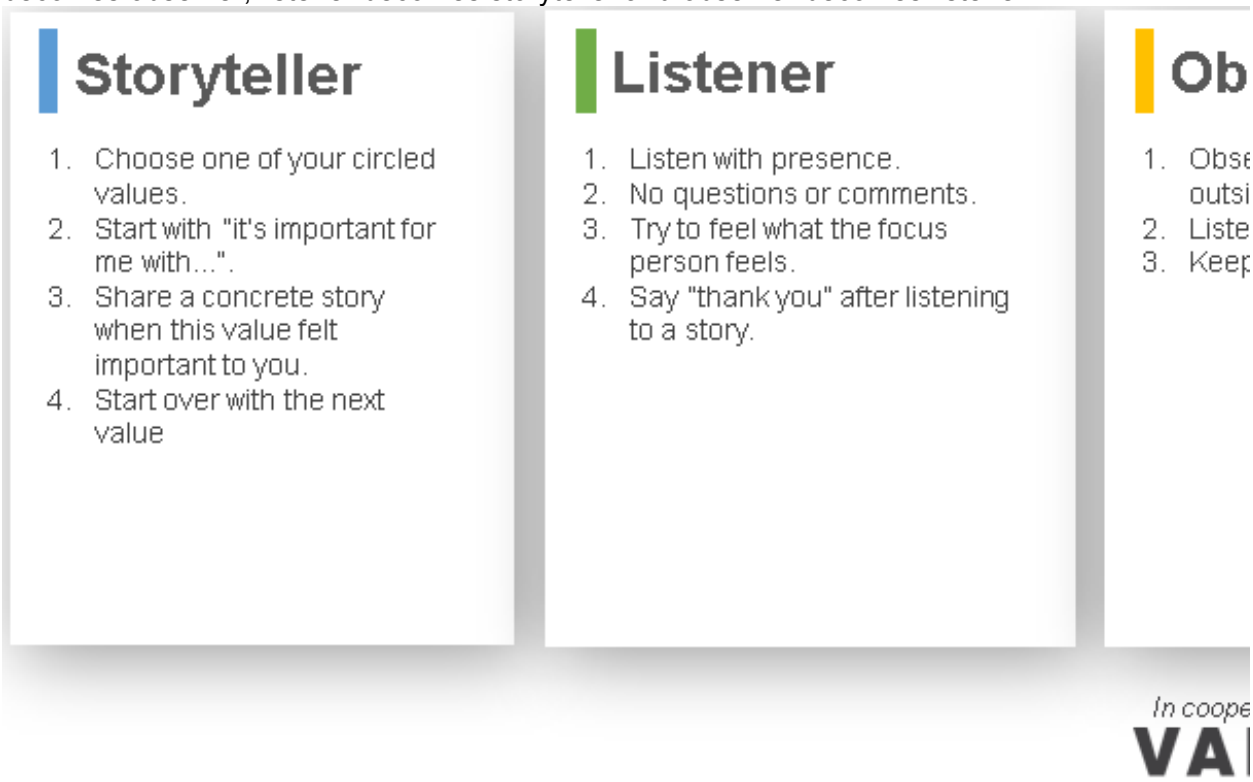
2. (5 min)
   Divide the participants in groups of two and have everyone discuss the things they wrote down

5. (5 min)
   Hand out the list of values from the Appendix to all participants. Ask each participant to underline the values that are important to them, not only in themselves but also in those around them. There is no limit for the amount of values the participants can choose. For the participants that have a hard time deciding, encourage them to simply follow their intuition and gut instinct. It is more than OK for the participants to add values not included in the list.

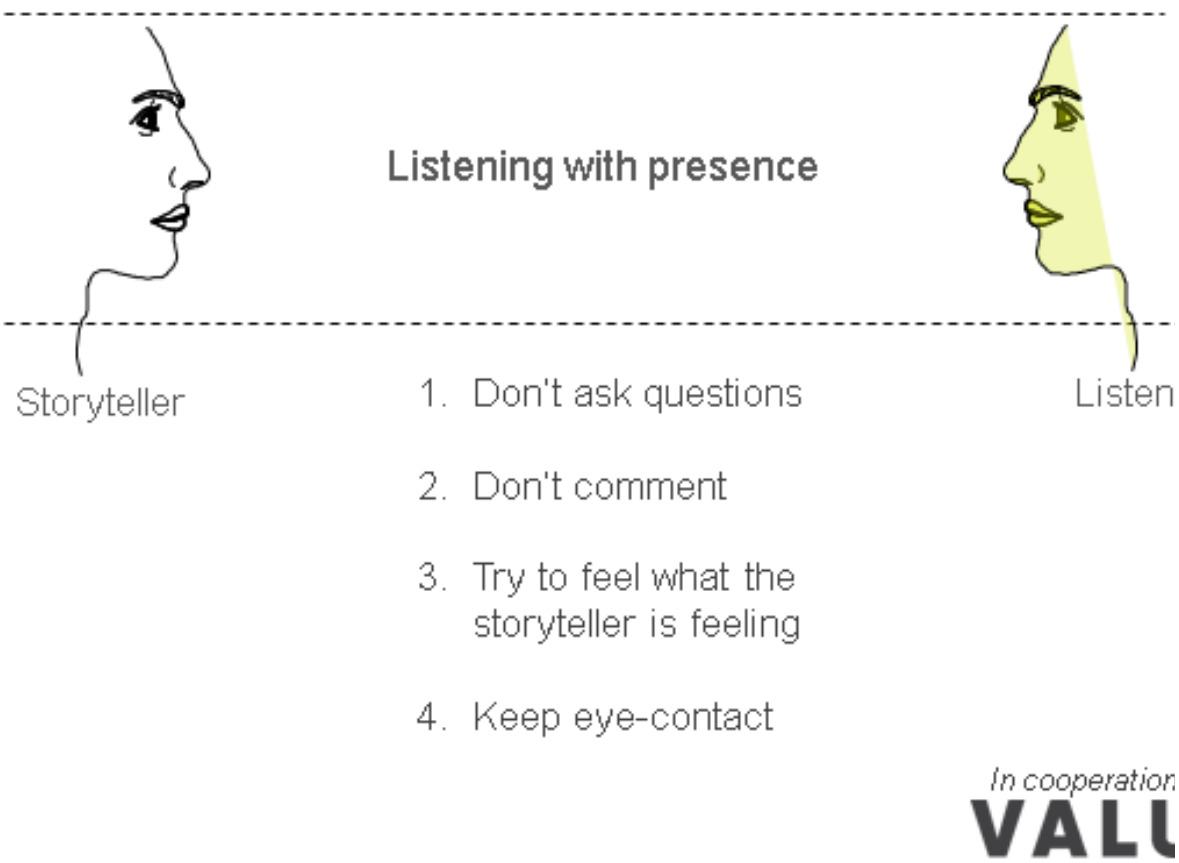
6. (3 min)
   Request everyone to go through their list and circle the top 5 values that resonate with them the most.

7. (20 min)

Divide the participants into groups of 3 and introduce the roles of the storyteller, listener and observer. It is also possible to do this in groups of 2 where the observer role is not included. The storyteller talks for 5 minutes, spending approximately 1 minute on each value. Encourage the storyteller to speak from personal experience. When 5 minutes have passed, the roles rotate. Storyteller becomes observer, listener becomes storyteller and observer becomes listener.



Really stress on the importance of active listening to enrich the experience of the participants.



8. (10 min)
   Wrap everything up by having an open discussion where all the groups are involved. Good questions to help initiating a dialogue:

a. Were there common themes between the group's chosen values?

b. What was the most difficult part of the exercise and why?

We have now laid out the foundation of what our personal values mean to us and how they guide our interpretation of the external world. Let us now have a look at how personal values can merge and create the group's values.

Part 2 - Determining group values

Time

- ~30-40 minutes

Facilitator instructions

1. (Until everyone is done)
   Start by letting each team member write down 5 values they would like to see and experience in the work environment, one post-it note per value. Do not rush through this part, let each participant take their time. It is OK to use the chosen values from part 1.

2. (5 min)
Let each participant rank the values from 1 to 5, with 1 being the most important. Then let each participant go forward to the whiteboard or wall and attach their top 3 values.

3. (10 min)
When everyone has finished hanging up their post-it notes, the entire group should stand in a horseshoe shape and together start categorizing these values. Simply, sort the values that strongly relate to each other into the same category. Let the team define the categories.

4. (5 min)
The team should now together pick one value from each category. These final values will give a good representation of the fundamentally shared group values.

5. (10 min)
Check out - Wrap everything up by once again having an open discussion.
a. Why did the group choose these values?
b. What does each value mean to the group? Ask everyone separately.
c. Which are the key insights from this exercise?
d. What was challenging in this exercise?
e. How will the group put these values into action throughout the project?
f. What could be the potential consequences of not following these values?
g. How could this workshop be improved?

Final notes
The aim with this workshop is to raise awareness and spark a realization on the importance of values. It is important for all kinds of organizations to continuously exercise and rehearse their core values to maintain authenticity, congruence and trust between its employees.
Practices like this allows the participants to actively reflect on one's experience in order to promote the self-improvement and development of the individual. Reflecting with the entire team will aid in the collective learning process the project brings about. By making self-evaluation more intentional and frequent, the members of the team can grow and prosper together.

Honesty	Concentration	Boldness	Acceptance	Intelligence	Fitness	Health	Enthusiasm
Discipline	Confidence	Brilliance	Accomplishment	Introversion	Flexibility	Wisdom	Encouragement
Discretion	Conformity	Calmness	Accountability	Intuition	Focus	Honor	Entertainment
Diversity	Consistency	Camaraderie	Activeness	Joy/Happiness	Freedom	Humility	Equality
Drive	Warmth	Openness	Beauty	Justice	Friendship	Humor	Excellence
Education	Creativity	Charity	Alertness	Leadership	Generosity/Sharing	Independence	Excitement
Effectiveness	Knowledge	Cheerfulness	Ambition	Learning	Gratitude/Thankfulness	Initiative	Experience
Efficiency	Curiosity	Collaboration	Appreciation	Liberty	Growth	Inventiveness	Exploration
Simplicity	Decisiveness	Commitment	Assertiveness	Love	Harmony	Inspiration	Extroversion
Energy	Dignity	Empathy	Kindness	Logic/Rationality	Vision	Integrity	Family
Modesty	Mindfulness	Maturity	Mastery	Order	Open-mindedness	Optimism	Motivation
Peace	Patience	Passion	Originality	Pleasure	Perseverance	Playfulness	Perfection
Proactivity	Privacy	Preparedness	Power	Resilience	Purposefulness	Reflection	Professionalism
Self-control/Self-Discipline	Security/Stability	Responsibility	Respect	Status	Spirituality	Spontaneity	Vulnerability
Teamwork	Sympathy	Success	Strength	Uniqueness	Trust	Truth	Timeliness

Table 1: example of values

Feedback Workshop

The purpose of this workshop is to create a foundation for a pro-feedback environment within the team. Making intra-group feedback a natural part of the project will give rise to a team of self-aware members. With this workshop, we will be creating a framework for the group that equips it with the right tools for rational decision-making.

The following exercise is a modified version based on the material from hyperisland.com. It has been specifically modified to suit the needs that encapsulates an iGEM project.

The workshop includes both a “check-in” and a “check-out”. The reason for doing this is to gather information about what the participants are feeling prior to and after the workshop. Checking in allows each member in a group to be seen, heard and connected to the present moment. It promotes a focused commitment towards the workshop. The participants get a general overview of the group’s collective intentions. Checking out allows the participants to reflect upon what they gained from the workshop. It is also an opportunity for the facilitator to learn how the workshop could be improved to better suit the needs of the unique iGEM team.

Agenda

Time

~40-60 minutes for a group of 10-15.

Preparations

- An open and relaxed space with preferably a whiteboard
- Whiteboard or large paper A1 or A2
- Pens

Facilitator instructions

1. (2 min)
   Create a circle of trust by obliging the participants to keep whatever is said during the workshop within the group. All opinions and personal stories stay within in the circle and are only shared with good intention.

2. Do a check-in. Go around the group and give each participant two post-it notes each. Ask the participants to write:

a. One desired personal outcome from participating in the workshop
b. One way the workshop could contribute to the iGEM project.

3. (5 min)
   Divide the participants in groups of two and have everyone discuss the things they wrote down

4. (2 min)
   On a whiteboard or large piece of paper, write the names of all the participants. Make sure to scatter the names to leave some space between each one

5. (10 min)

Ask the team members to start mapping out their working relationships with each other. E.g. Albert draws an arrow connecting him to Peter. Along the arrow, Albert writes one or two words that encloses e.g. a human practices or wet lab project they have been working. All participants should draw as many lines as possible to the other team members.

Continue until the chart is full of connections. The chart is also a good way of mapping out the intra group relationships.It makes the team members aware of where connections to the other members are missing.

6. (3 min)

Ask the participants to circle 2 specific connections that they'd like to give feedback on.

(2 minutes per feedback session)

7. Have the involved parties group together and start giving/receiving feedback. A feedback template to follow could be.

a. The giving end starts by recapping the interaction while highlighting the positive aspects of it

b. Suggest 1 negative aspect of the interaction followed by a suggestion of how the receiving end could improve.

c. The receiving end takes notes during the session and simply replies with a "Thank you" after the session is over.

This step may cause ques as one person might have several connections to him or her. Try to organize it in the best way possible.

8. Check-out: Reorganize the group and ask the following question

a. How did it feel to reflective on your interactions with the other members? Did you feel that giving feedback was difficult or hard?

b. What was the most challenging aspect of the exercise?

c. Did the exercise generate any personal insights about your thinking? Would you like to share with the rest of the group?

Creativity Workshop

There are a lack of pragmatic exercises to practice and teach creative working strategies. This workshop is made with the intention to strengthen the group's collaborative brainstorming ability and to generate creative thinking processes within the group. The following exercise allows the team members to come up with innovative concepts by combining different ideas.

The workshop includes both a "check-in" and a "check-out". The reason for doing this is to gather information about what the participants are feeling prior to and after the workshop. Checking in allows each member in a group to be seen, heard and connected to the present moment. It promotes a focused commitment towards the workshop. The participants get a general overview of the group's collective intentions. Checking out allows the participants to reflect upon what they gained from the workshop. It is also an opportunity for the facilitator to learn how the workshop could be improved to better suit the needs of the unique iGEM team.

The following exercise is a modified version based on the material from hyperisland.com. It has been specifically modified to suit the needs that encapsulates an iGEM project.

Agenda

Time

- 60-90 minutes

Preparations

- Post-it notes or index cards
- Pens
- An open and relaxed space with a wall or whiteboard for attaching notes
- Background music, preferably something up beat to energize the exercise

Facilitator instructions

1. (3 min)
   Brief the participants on the instructions of the workshop.

2. (5 min)
   Do a check-in. Go around the group and give each participant two post-it notes each. Ask the participants to write

a. One desired personal outcome from participating in the workshop
b. One way the workshop could contribute to the iGEM project.

3. (5min)
Divide the participants in groups of two and have everyone discuss the things they wrote down

4. (10-15 min)
The workshop is started by brainstorming around areas such as:

a. Technologies (e.g cars, smartphones, CRISPR, lab on a chip, bioinformatics, biosensoring)
b. Human needs (e.g. medicine, food, entertainment, protection)
c. Global issues (e.g. pollution, hunger, disease, inequality, obesity)
d. Resources (e.g. industry, organisations, researchers)

You may modify these areas to better suit the aims of e.g. your project idea or human practices initiatives. Spend 3 minutes brainstorming on each area. Each participant should write down as many ideas as possible on post-it notes and place them on the wall or whiteboard, one idea per post-it note. Have the participants call out the idea as they place it.

5. (15 min)

Divide the participants into groups of 2-4 depending on the number of participants. The task now is for each group to create new concepts by merging different ideas. A new concept consists of at least 2 ideas from the wall combined together. For each combination of ideas, the group must give this new concept a catchy and memorable name. E.g: biosensoring, textile dye pollution could have a name such as “DyeSense”

Play some up-beat music and let all participants stand up during this part. The goal is to create a fast-paced atmosphere and promote rapid thinking.

6. (15-20 min)

Once the time is over, have each group present all of their ideas during 5 minutes each. You as the facilitator write all of these down and post them on the wall.

7. (30-40 min)

Let each group decide on <u>one</u> of these ideas and develop it further by exploring its details, functionalities and perhaps a business model. Participants could e.g. suggest the product’s targeted market, strengths and weaknesses, its feasibility and the required technological tools for realizing this idea. The participants are allowed to use resources such as the internet or books to retrieve more information regarding their idea. The objective of this step is for each team to create a 3 minute presentation that is presented in front of the entire group.

8. (10 min)

Check-out: Review the workshop experience by asking the participants the following questions:

a. How did it feel to work in this way? Did you feel that your creative thinking was improved? Why? Why not? Would you like to share with the rest of the group?
b. What was the most challenging aspect of the exercise?
c. Did the exercise generate any personal insights about your thinking? Would you like to share with the rest of the group?
d. Do you think this could be applied in the actual iGEM brainstorming? Why? Why not?