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# Constructing a 'Team' Robot

## 1. 'Team' Robot vs. Individual Ownership

A 'team' robot is a robot that is constructed by a team. It does not belong to one individual instead it belongs to the entire team, as the name implies. Being able to work as a team and create a product is an important skill for everyone to learn. Employers look for people who are 'team players.' Great achievements in life are usually developed by teams of individuals not by individuals alone.

Botball provides a great opportunity to develop team building skills. Groups of students work together to complete a project. Each team member has a vital role in the process, but the success of the project depends on how well the different groups (such as, building, programming, and strategizing) develop the plan together and cooperate.

### 1.1 The 'Mine' Syndrome

I have coached Bobtall teams for the past 6 years. Each year I start out with great optimism determined that this year will be the year my team will work together cooperatively and construct a 'team' robot. But alas, every year I sit and watch as the team turns into a individual ownership corporation.

I've seen it happen over and over. Three members of the building team may start out on a robot, with great plans to work together, but somewhere along the way, they fall victim to the 'mine' syndrome. The robot always seems to become the property of one individual. It's Marshall's robot, or Leah's robot, or Brandon's and no one else better touch it or change it in any way for fear of life and limb. Messing with someone's robot is grounds for banishment or punishment and, of course, it is cause for yelling and even tears. The bond becomes so strong between botballer and robot that at the end of the season certain individual members are heartbroken to have to dismantle their robot. I still have team members with robots intact from two years ago. They just won't part with their creation. It has become more than property, an entity, with a name and personality all its own. See Figure 1, Giraffa.

Figure 1: Giraffa

Leah carefully sets up her beloved robot Giraffa at the Botball national tournament in Jacksonville, Florida, 2005. Giraffa still proudly sits on Leah's desk at home today,

## 1.2 'Secret Strategy'

'Secret Strategy' seems to become the mode of operation in the planning department as well. The plans for each robot's functions are kept secret as if they were a matter of national security with no one allowed to divulge any information. I have even had two team members from the same team work for weeks developing the two team robots and then find out that they are doing the same task instead of two different ones. Obviously there wasn't much communication going on between them, until then. Unfortunately it manifested itself in the form an argument about who had to change their robot.

## 1.3 Programming

Programming is also a individual matter until there is a problem. Then everyone turns to the one team member who understands IC for answers, but of course, he doesn't really understand what the other robot is suppose to do so helping with the programming is difficult. This is always happening during the last week of the season right before regionals. For some reason this seems to be considered the appropriate time for programming your individual robot.

## 1.4 Individual Ownership Paradigm

Once the 'individual ownership' paradigm sets in with Botballers, it seems to be difficult to break. Team members who have already been individual owners of a Botball robot come back each year with the same mind set. They may talk about working together and even assign different tasks to each team member at the beginning of the year, but as the season unfolds, individual ownership rears its ugly head again. Robots become individual property and their operation becomes personal. One team member develops their robot and is the only one privy to knowledge of its set up and operation.

# 2. 'New Team' Opportunity

Botball 2007 rolled around and I was presented with a unique opportunity - a new team. With this also came the possibility of new hope for a 'team' robot. The team was a community team with students from different schools. None of the team members had previously participated in Botball. A few of them had worked with building robots for the FIRST LEGO League, so there was some experience with team building. I had renewed hope that this group might be capable of building the 'team' robot.

## 2.1 Team Plan

The team decided that the first order of the day was to develop a team plan and schedule for the entire Botball season. I didn't know it at the time, but this was a great move towards helping the development of a 'team' robot. Another important factor was the make-up of the team. There were about 10 members who wanted to participate but they couldn't all attend on the same days. The coaches could meet everyday after school, but individual team members could only meet on certain days. So small groups of students emerged from within the team. These were designated in the meeting schedule. See Figure 2: Master Schedule. The team captain would try to be present at all of the meetings and the whole team would try and meet together once a week to give consistency to the team effort.

| Date | Weekly Goals / Daily Activities | Team Members |
|---|---|---|
| 3/5-3/10 | Complete 2nd Robot; Write Pseudo Code for 1st Robot; BOPD Simulate Pseudo Code for 1st Robot; Test Prototype 1st Robot; Build Wheel Assembly 2nd Robot; Build Chassis 2nd Robot; | |
| 3/5 | Build 2nd Robot Wheels; Design Chassis 2nd Robot | Group 1; Alex |
| 3/6 | Build Chassis 2nd Robot; BOPD | Group 2 |
| 3/7 | Simulate Pseudo Code 1st Robot; Test Prototype 1st Robot BOPD | All |
| 3/9 | Test Prototype for 1st Robot; Finish chassis 2nd robot | Group 1 & 3 |
| 3/12-3/17 | Complete 2nd Robot; Write pseudo code 2nd robot; Write Flow Charts; Write IC Code both Robots; Evaluate Mechanical Design Based on Simulations; Re-design Any Defective Parts; | |
| 3/12 | Write pseudo code 2nd robot; Finish 2nd BOPD | Group 1 |
| 3/14 | * 2nd BOPD DEADLINE; No Team Meeting | Group 2 |
| 3/15 | Add Servo Arm to 2nd Robot; Start IC Code; | All |
| 3/16 | * 2nd Robot Complete;<br>* Complete Programs for Both Robots; | Group 3 |
| 3/17 | Meeting with JGMS/PDMS/LQHS to Share Experiences/Help | All |

Figure 2: Master Schedule

## 2.2 Meeting Notes

Another tool that the team came up with for organization was to keep meeting notes. The team meeting notes consisted of a list of meeting days by weeks. Each week was given a set of goals to be accomplished and each day was assigned tasks relevant to these goals. At the end of each meeting day, one team member (different ones each time) wrote down what happened at the meeting and what was accomplished. They tried to list these by the different activities like building, strategy, or design.

Each day the team sub group would come in and look at the schedule to decide what the activity was suppose to be. Then they would read the ream meeting notes from the day before and see what was done. Now they could pick up where the other group had left off. For example:

## *Goals for the Week of Feb. 19:*

***Find Ways to Use the KISS Principle;Team Strategy; Draw Out Strategy Plans; Design, Build, and Have 1st Robot Body Moving to Complete 1 Simple Task (go forward); Game Board***

### *Tuesday, Feb 20*

**Activities: Design Wheel Base; Design Chassis; BOPD;**

Game Board: We got the pvc pieces for the houses, and got the pvc pipe for the center section. We need to finish cutting the pvc and build the center section. We have the volcano but not the single center pvc pipe.

Designs: Two team members worked on the design for the wheels and gear train. They tried several gears and decided upon the bevel gears 16 to 24. We are using the white motors. The motors are held in place with axles between beams, no glue.
We took notes for the BOPD. We need to work on this more.

### *Wednesday, Feb. 21*

**Activities: Discussion of KISS Principle Ideas/Team Strategy; Build Wheel Base/Chassis; Design Arm**

KISS / Team Strategy: We each answered question about what KISS means, what it means to be a team member, and what we want to learn from Botball. (See Team Documents page #4- Questions 1)
We decided to all groups would work on all of the parts- designing, building, testing, programing. Which ever group was working that day they will work on what needs to be done. We also decided to make our robots modular with the different parts being separate and then put together. So while one or two students work on the wheels, another can work on the chassis, and another on the arm. But the next day different group might continue the work on the wheels or chassis. The team captain is in charge of making sure he knows what the plan is with each part so he can direct the work.
Building: One student worked on building the wheel gear train and two others on the chassis.
Design: Two students worked on their own designs for an arm.

### *Thursday, Feb. 22*

**Activities: Test the Wheels; Test the Chassis; BOPD**

Wheels: We put the two wheel bases together and tested them by pushing them with our hands to see if they ran smooth and were strong. They seemed to work great. One student figured out how to attach the wheels to the chasses and we pushed it around on the board.

**Friday, Feb. 23**

**Activities: Write Short Program; Draw Out Strategy Plans; BOPD**

Strategy Plan: We drew out plans and decided upon one. (See Team Documents on page #5-Questions 2 and on page 6 - Planning Documents)

Program: We wrote a short program that moves the robot forward for 2 seconds just to see if the motors worked and the robot would go straight. The first time we had the motors plugged in the wrong way so the robot went in a circle. Next the robot jumped forward very jerky. It was the legs that were touching the ground in the front. The weight of the xbc and gameboy pushed them too hard on the ground. We took the off and it went fine, but not straight.

Game Board: We finally cut the pvc to finish the board; Subgroup worked on BOPD.

### 2.3 The Most Important Rule

In order for each of the sub groups to be able to come in and continue work on the robots, the team decided that there needed to be some rules. They came up with one most important rule that allowed for success. It was:

**"No one is allowed to take anything apart."**

Instead of taking apart what the previous group had build, if a team member felt he had a better way of building a part or section, he was to build it out of other LEGO. Then it could be evaluated later and the best way could be decided upon by the whole team and chosen for the team robot. This strategy worked well. Everyone on the team had some hand in building the first robot. No one thought of the robot as their own personal work, but viewed it as a cooperative project.

## 3. Advantages

Having a 'team' robot produces some significant advantages for the team. The first, and one that is very important, is that the team learns how to work together. This involves developing the art of communication. Without meaningful communication this type of plan will not work. Each sub group needs to know what the other groups are doing. The entire team needs to understand the basic strategy and what specific plans have been decided upon by the team as a whole. But when this happens everyone on the team has a more worthwhile experience in the process.

Team spirit is also developed through better team cooperation. If everyone is having fun and the team is accomplishing its goals, then team spirit will be high.

## 3.1 Improved Design Through Different Approaches

Having different people work on the design and building process is advantageous. To explain, let's take the example of Alex and the cradle attachment. After the regional competition the team decided changes in the design of the cradle was needed. This robot captured the 3 huts and contained them in a row with a cradle.

In the regional design the cradle was at the front of the robot. This caused problems with navigation and turning for the robot. The team decided that the cradle should be moved to the side of the robot and that the front should have flared pieces to catch the huts even if the robot was slightly off position. Groups one and two designed and built the new cradle piece and the flared system worked great. But the design caused a problem with attaching the cradle to the robot. The flared pieces had the LEGO holes going up and down whereas the robot had the LEGO positioned with the holes going sideways. Now, the members had to figure out how to attach the two different alignments. They could see that the two different alignments needed something to mesh them together so they started on a course of finding LEGO pieces that would change the orientation of the LEGO holes. They tried but did not succeed.

The next day, Alex came in with a different sub group. Two of the members started working on the BOPD and Alex began to look at the cradle problem. He studied it for awhile and then came up with a very simple solution. There was a LEGO beam already attached to the robot that was designed to hold the two sections of the robot modular system together. It was a short beam, but Alex could see that if this beam was longer it would stick out between the treads of the wheel system and the cradle could easily attach to it. The beam was already in the correct alignment because of the way it was attached. The other team members came back the next day and marveled. They were so fixed on changing the orientation of the LEGO holes that they didn't even consider the piece already attached to the robot doing another job. Alex had not been there to get in their mind set, so he could see a different approach. And as we all know, a different approach can provide the solution to a difficult problem.

## 3.2 Conclusion

With this new team came new ideas about cooperation and team work. Now I have plans to try and implement this strategy into all my Botball teams. This experience has helped me to readjust my strategy for coaching a Botball team. Hopefully the teams, new and old, for next year will be able to truly build a 'team' robot and avoid the pitfalls of individual ownership.