Inertia, Aspirations, and Response to Attainment Discrepancy in Design Contests

Abstract

The process of evaluating performance relative to aspirations is widely used by many studies of organizational and technological change. The standard performance feedback model argues that decision makers act in function of attainment discrepancy between performance and aspirations. The theory also states that response to attainment discrepancy is influenced by inertia. Organizational research suggests that there are two types of inertia that we identify in this paper as performance-based inertia, and non-performance-based inertia. We examine the influence of these two types of inertia on the two types of attainment discrepancy as identified by standard performance feedback theory: attainment discrepancy that is based on historical aspirations and attainment discrepancy based on social aspirations. We examine mechanisms that account for the influence of both types of inertia, and derive hypotheses that predict their moderating effect on attainment discrepancy. We test these hypotheses using data on 112 teams that participated in "Robot Wars", a tournament organized as a contest between teams that field machines specifically designed for the event. Our dependent variable is the magnitude of design change prior to participating in each tournament. Our results show, as predicted, that: performance-based inertia negatively moderates design change in response to attainment discrepancy that is based on social aspirations and; non-performance-based inertia negatively moderates design change in response to attainment discrepancy that is based on social aspirations. However, contrary to our predictions, our results show no relationship between non-performance-based inertia and design change in response to attainment discrepancy based on historical aspirations. We find a positive and significant result for the relationship between performance-based inertia and design change in response to attainment discrepancy based on historical aspirations. Our study contributes to research on the relationship between performance feedback and technological decision making in contexts where inertia can alter assessment of new product introduction risks.

Key Words: Performance Feedback, Attainment discrepancy, Aspirations, Inertia, Decision making.

1. **Introduction**

A common problem that faces managers in technology based industries such as mobile phones, or computer memory, where product improvement is essential to competitive advantage, is how far they should innovate current designs in response to competition (Giachetti and Lampel, 2010; McKendrick and Wade, 2010). Some managers may argue that incremental improvements of existing designs are sufficient if revenues are strong; others may argue that it is important to aim at radically innovative designs to reinforce the business unit's competitive position. Both options have risks: An incremental improvement may in retrospect be a poor choice if a competitor leapfrogs ahead, but introducing a radically new product may also turn out to be risky if consumers fail to appreciate the performance benefits offered. Simply put, managers face a situation where it may be risky to do too little, and risky to do too much.

Performance feedback theory argues that how far decision makers go towards taking more or less risks in such situations is strongly influenced by the discrepancy between performance and aspirations, the so called "attainment discrepancy". A substantial body of empirical research has accumulated that validates this basic assumption. But as Shinkle (2012) points out in his summary of this body of literature, the research is incomplete. As he puts it: "while it is widely accepted that organizational aspirations influence strategic behaviour, the moderators of the aspiration–consequence relationship are understudied" (Shinkle, 2012, p. 417). One of the key moderators that are understudied is inertia, defined as a strong commitment to existing markets, technology, and production systems (Lant, 1992; Baum, Rowley, Shipilov and Chuang, 2005; Thompson, 1976; Wilson, 1991; Baum, Li and Usher, 2000).

Inertia figures prominently in studies that examine innovation and change from a performance feedback perspective. The theory predicts that because inertia increases commitment to what organizations are doing already, all other things being equal, this will decrease their willingness to innovate in response to increasing attainment discrepancy. For researchers who study inertia at the intra-organizational level what is striking about performance-feedback theory is that it makes no distinction between different types of inertia (e.g. Sigglekow and Rivkin, 2005; Stieglitz et al., Forthcoming). This is in contrast to the broader organizational literature that identifies different kinds of inertia. Two types in particular have received most attention from researchers in this area (see Miller, 1993; Hodkinson and Wright, 2002; Stiglitz, 2015). The first is inertia that results from interpreting a long track record of small attainment discrepancies as confirming that change to current products and operations is not necessary to maintain good market performance (Labianca et al, 2009; Ketchen and Palmer, 1999). The second is inertia that emerges from within the organization; the result over time of interaction among structures, systems, procedures, and processes that gradually constrain change (Hannan and Freeman, 1984; Tushman and O'Reilly, 1996).

The question that we wish to address here is whether both these types of inertia negatively moderate the relationship between attainment discrepancy and innovative activity as predicted by performance feedback theory. To address this question we have to take account of the fact that while performance feedback theory assumes only one type of inertia, it maintains that there are two types of aspirations: self-referential aspirations based on the decision makers' own performance, usually referred to as 'historical aspirations', and aspirations based on external reference points, most often rivals' performance, and are categorized as 'social aspirations'. If we take the insight from organization studies that there are two types of inertia, and combine this with the view of performance feedback theory that there are two types of aspirations, the question stated above must be expanded to include the impact of each type of inertia on attainment discrepancy produced by historical and social aspirations respectively.

Addressing the impact of both types of inertia on response to attainment discrepancy is the main contribution to performance feedback theory that we wish to make in this paper. We also believe that our paper makes a methodological contribution to the problem of operationalizing attainment discrepancy in performance feedback research that has been for long stymied by the difficulties of measuring managerial aspirations in natural settings. Confronted with this problem has led researchers to focus most of their efforts on computer and laboratory simulations with human subjects (Bendor and Moe, 1985, Herriott, Levinthal and March., 1985; Lant and Mezias 1992; Larsen and Lomi 2002; Rahmandad, 2008). In his literature survey Shinkle (2012, p. 417) provides further confirmation for the methodological obstacles that face researchers. He finds that of the 62 empirical articles that examine performance feedback theory, only 5 measure aspirations of firms *in situ,* and of these, 3 measure aspirations in entrepreneurial firms where a single individual can be queried. In this paper we suggest that tournaments provide settings that can be used to study with greater precision how decision makers respond to attainment discrepancy because actors must compete under conditions that are explicitly specified, but at the same time mirror some of the dynamics of naturally occurring competition. The use of tournaments to study a wide range of economic and organizational processes has generated a substantial body of research (Connelly, Tihanyi, Crook and Gangloff, 2014). There is also an extensive body of literature that examines the use of tournaments and contests as tools for encouraging innovation (e.g. Morgan and Wang, 2010; Boudreau, Lacetera and Lakhani, 2011). The advantage of using a tournament such as *Robot Wars* as a research site is that the competitive outcomes are clearly demarcated and known to all participants, i.e. performance is not ambiguous, and narrowing the choice of reference points that drive aspirations is much easier to establish.

In this paper we use data from “Robot Wars”, a series of elimination tournaments organized as a contest between teams that field remotely controlled machines. We use data on 112 teams that participated in at least two of the seven tournaments *Robot Wars* to examine the impact of performance-based and non-performance-based inertia on historical and social aspirations.

Our paper is structured as follows. In the next section we provide a brief overview of the theory. We then develop four hypotheses from theory - one each on the moderating effect of two types of inertia on the relationship between each of the two types of aspirations and design change. Thereafter we outline our research site, provide a description of the data, and follow this with a discussion of our measures. We then present and discuss our results. We conclude after discussing limitations and implications of the study.

2. Inertia, attainment discrepancy, and design change: Theory and hypotheses

2.1.Impact of performance-based inertia

Let us start with the impact of the first type of inertia which is based on managerial interpretation of past performance record, which for the purposes of this discussion we call ‘performance-based inertia’. Researchers have pointed to a number of factors that induce performance-based inertia. Miller (1993), for example, argues that successful performance induces managerial “blind spots”. Hodkinson and Wright (2002, p. 951) speak of ‘strategic inertia’ which results from the “habitual reliance on a (previously successful) organizational 'recipe' or success formula”. Audia, Locke, and Smith’s (2000, p. 837) likewise show that past success “may set the stage for dysfunctional persistence” by increasing decision makers’ sense of self-efficacy. Ranft and O’neill (2001, p.126) echo this point strongly, maintaining that high-flying firms develop a form of "cautious conservatism and perhaps arrogant disdain". In his examination of Intel's strategy, Burgelman (1992) also shows how the successful performance of company's strategic initiatives led to a co-evolutionary lock-in with the personal computer market that reduced propensity to innovate new business lines.

Most of the research on performance-based inertia examines its impact on organizational change in general. Our interest here is in the impact of performance-based inertia on product innovation, specifically on design decisions. Performance-based inertia in this case is based on the decision-makers' performance track record; in other words, the strength of past market performance of the organization's products (Greve, 2007; Gaba and Joseph, 2013). From this it follows that the stronger the market performance of products introduced to the market previously, the less likely are decision makers to make significant design changes. This is a general prediction of the influence of performance-based inertia on innovation, based on the argument that a strong performance track record increases the confidence that decision makers have in their existing products and product lines.

Performance feedback theory, however, suggests that the propensity to innovate is also a function of two types of aspirations, historical aspirations and social aspirations (Labianca et al, 2009). Historical aspirations are based on recent performance, in our case the performance of the last design that the organization introduced to the market. Performance feedback theory also suggests that performance-based inertia influences how decision makers react to attainment discrepancy that is on historical aspirations. The theory predicts that the magnitude of this influence will shape the risks/benefits assessment of making design changes. Thus, decision makers will react differently to the attainment discrepancy of the same magnitude if one has high performance-based inertia while the other has low performance-based inertia. More specifically, the decision maker with high performance-based inertia will interpret discrepancy attainment as requiring less product design changes than the decision maker with low performance-based inertia. This gives us the following hypothesis.

Hypothesis 1: Performance-based inertia will decrease extent of design change that decision makers undertake when discrepancy attainment is based on historical aspirations.

In contrast to historical aspirations that are based on the decision makers' own performance, social aspirations are based on competitors' performance. In effect, decision makers base their aspirations on benchmarks defined by the performance of rivals. When it comes to deciding how far the organization should go in modifying product design, decision makers are influenced by discrepancy between the performance of their current design and the performance of their rivals' design - the latter's performance forming the basis for their aspirations. In general, the bigger this attainment discrepancy, the more likely are decision makers to change the design because they see an increasing discrepancy magnitude as signalling loss of competitive position (Giachetti and Lampel, 2010; Joseph and Gaba, 2015). But here as well, performance-based inertia will moderate the impact of the discrepancy on decision making. Decision makers in organizations with higher performance-based inertia are more likely to discount the threat posed by increasing attainment discrepancy compared to decision makers in organizations with low performance-based inertia. As a result, the first undertake relatively less modifications to their product designs. This gives us the following hypothesis.

Hypothesis 2: Performance-based inertia will decrease the extent of design change that decision makers undertake when discrepancy attainment is based on social aspirations.

2.2.Impact of non-performance-based inertia

Let us turn our attention now to the impact of non-performance inertia on historical and social aspirations. Whereas an organization's past performance record is the source of performance-based inertia, non-performance inertia arises from processes that are rooted in psychological dispositions, social interaction, and political dynamics common to all organizations (Carrillo and Gromb, 2006; Briscoe and Tsai, 2011). Studies trace the emergence of non-performance inertia to a number of mutually reinforcing sources. Inertia may be built into the structure of organizations at birth, as Hannan and Freeman (1977, 1984) maintain; or, as Prahalad and Bettis (1986) argue, it emerges gradually as executives develop beliefs about causes and effects that resist revision as the environment changes. Briscoe and Tsai (2011, p. 410) comment that inertia "arises from the inevitable complexity of interdependent structures, policies, routines, and roles, all of which constrain managers in their capacity for action". Mellhai and Wilkinson (2004, p. 30) point out that "over time successful routines develop into habits and routines become traditions, with the effect of preserving the firm's way of doing things". Tushman and Romanelli (1985, p. 192), likewise suggest that over time, strategic processes "become routinized, commitment to established practices increases as groups become more rigid in their behavior patterns and decrease both the volume and diversity of information processed".

As in the case of performance-based inertia, non-performance inertia exercises a negative moderating effect on the reaction of decision makers to attainment discrepancy. In the case of historical aspirations, research suggests that this negative moderation is likely to be strong because processes used to set historical aspirations are influenced by structures and deeply embedded routines that give rise to inertia (Hodgkinson and Wright, 2002). Put differently, the self-referential nature of historical aspirations is likely to be reinforced by inertia that is a product of internal organizational processes. In terms of decision making this means that a high level of non-performance inertia will reduce the valence of attainment discrepancy. Thus, decision makers in two organizations that set the same historical aspirations, will react differently to the same attainment discrepancy if non-performance inertia is high in the first and low in the second. More specifically, decision makers operating in an organization with high non-performance inertia are less likely to undertake the challenge of making major design changes to their products as opposed to decision makers that operate in an organization with low performance-based inertia. This gives us the following hypothesis:

Hypothesis 3: Non-performance-based inertia will decrease extent of design change that decision makers undertake when discrepancy attainment is based on historical aspirations.

Finally, we turn our attention to the impact of non-performance inertia on social aspirations. When decision makers set aspirations based on the performance of other reference organizations, an inevitable tension arises between the conservative tendencies of non-performance-based inertia and social aspirations; especially when the referent organization that is used to set social aspirations is a high performer. As noted by Mellhai and Wilkinson (2004), and by Tushman and Romanelli (1985), the age of the organization can play a role in the reliance on social aspirations. Organizations with relatively short history, i.e., with low levels of non-performance-based inertia, are more likely to use social aspirations not only as a crucial benchmark for evaluating their own performance in the preceding contest, but also as a source of new design ideas (Short and Palmer, 2003). By contrast, stronger conservative tendencies due to higher non-performance inertia will result in a different evaluation of performance. Faced with the same attainment discrepancies that are based on competitors' performance, decision makers with high non-performance-based inertia are more likely to attribute this discrepancy to random factors (e.g. sudden change in consumer tastes) that do not require fundamental review of the organization's processes and procedures. This in turn should have consequences for the willingness to modify the current product designs. Decision makers with high non-performing inertia are less likely to pursue major design changes, whereas those with low non-performance inertia are more likely to be motivated to do so. This gives us the following hypothesis.

Hypothesis 4: Non-performance-based inertia will decrease extent of design change that decision makers undertake when discrepancy attainment is based on social aspirations.

3. Research site

Robot Wars is one of the labels given to the sport of Robotic Combat, described as the first sport to break into the popular culture in the new century (Stone, 2001, 2003). *Robot Wars* is a tournament-style competition in which contestant teams compete using remotely controlled robots in a purpose built arena under rules laid out by the organizers. The teams and their respective robotic designs progress through multiple stages that comprise several combat-shows leading to the final stage where the tournament winner is decided. Each contestant team can be regarded as a learning unit, and each tournament is therefore considered as a performance feedback episode that produces learning. The goal of *Robot Wars* is to provide spectator entertainment by encouraging novel robotic designs in combat.

Each *Robot Wars* tournament is arranged in rounds. Each round in turn is made up of battles where contestant teams pit their designs against rivals. The first round of the tournament pairs off competitors from all teams that enter the tournament. Because the number of teams that enter will vary from tournament to tournament, the number of battles in the first round will therefore also vary. The rules of Robot Wars, however, stipulate that only eight teams are allowed to progress to the second round. After this, the process of elimination means that only four winners from the second round progress to the third round, or the semis, and the final or fourth round is where the two finalists battle it out to decide the tournament's winner. The performance outcome of each battle is judged in two ways: When a robot is disabled or knocked out, the combat ends, and victory is conferred on the robot that is in working order and still in the arena. If at the end of the battle both robots are in working order the winner is decided by a panel of judges. In either of the two scenarios, the robot that has been declared the winner advances to the next stage, and the one that lost is eliminated from the contest.

4. Data and sample

Our analysis is based on a purposive sample of 112 contestant teams from a population of about 300 teams in *Robot Wars* over the seven tournaments that comprise it. The sampling includes all teams that participated in more than one of the seven *Robot Wars'* tournaments. Ten teams that met the criteria of participation and continuity were nevertheless excluded from the sample due to missing data on the specifications of the robotic design. Each successive tournament, before and after, in which the contestants participated is one observation. Therefore, the total number of such *observations* in our sample that we analyse is 169.

We collected data on each of the teams our sample from web-based archival sources that contained complete information on seven successive tournaments of the *Robot Wars,* spanning five years, from 1998 to 2003. The data consist of the design specifications of the robotic designs entered into the contest by each of the contestant teams (Hobbins, 2002; Mountjoy, 2007).

5. **Measures**

5.1. Dependent variable: Design Change

Design change (DC) in tournament 'N+1', represents the dependent variable for this study. To construct this scale we first looked at design change typologies that have been developed within the wider theoretical perspective of innovation typologies (Garciea and Calantone, 2002). Design change typologies of systems, such as the ones we are studying in this paper, are generally based on a distinction between change in components and change in functional performance as a result of major subsystem or architectural change, and the interaction between the two levels over time (Henderson and Clark, 1990, Tidd, 1995). This usually results in a tetra categorization of change (Garcia and Calantone, 2002).

In our case, initial technical analysis of all the robot machines that participated in the tournaments showed that as expected, design change was oriented to improve the fighting capabilities of the machines. Broadly speaking this meant that machines were made bigger and heavier in order to better withstand and launch attacks, and/or the machines employed new weapons to improve attack effectiveness. Our initial analysis suggested that machines could be made bigger and heavier without changing weapon subsystems, but that changing weapon subsystems usually led to changes in machine dimensions and weight. However, because both size and weight confer fighting advantage, some teams pursued change in both directions, i.e. they incorporated new weapon systems, and increased the size and weight of the machines beyond what that would be required for installation of new weapon systems.

At this point we had the basic categories of change, and based on our initial analysis we also had their rank ordering However, we needed to further validate these categories, as well their rank ordering from low to high design change. To do this we made use of extensive video and online archives generated during the Robot Wars tournaments. A particularly useful source of data were the televised interviews with teams prior to, and following, their first tournament round. With few exceptions teams were asked what is new in their design compared to the last tournament. Their response and comments from experts interviewed during the programs were collected and analyzed. We also analyzed narratives, comments, and exchanges in online discussion forums dedicated to Robot Wars. Some of these online postings were done by participating teams; others by Robot Wars enthusiasts. The final analysis led to four categories of design change, in the following order of change magnitude:

DC=1: Design change in physical specifications that only involves changes in the physical dimensions and weight of the deployed design.

DC=2: Design change only in functional specifications, or specifications of design that are cited in relation to combat performance in narratives of the contest. Examples of these are ground clearance, weapon, and engine power.

DC=3: Design change where both physical and functional specifications change but the changes are closely interrelated. For example, the team changes the weapon (functional feature) of its deployed design from a flipper to a hammer, but the change in associated height (physical feature) of the design is largely attributable to this change of weapon.

DC=4: Design change where both physical and functional specifications change but the changes are unrelated. To illustrate, we can again take the example of a team that changes the weapon (functional feature) of its deployed design from a flipper to a hammer. Though the change in associated height (physical feature) in this case is largely attributable change in weapon, we find that the design is also characterised by a changes in its length and width (physical features), which is not due to the change in weapon.

5.2. Predictors

5.2.1 Aspirations

Historical Aspirations (HA_n): In *Robot Wars*, it can be argued that each time a team prepares for a new tournament it is intent on securing outright victory. This in turn should drive the team's design change efforts. In practice, aspirations, and hence the effort invested in design change will be based on an estimate of how likely the team is to achieve such outright victory. This estimate is based on two elements. The first is how likely is the team to do as well in the new tournament as the last one, and the second is the probability of wining the next tournament if it manages to make it through the round in which it was eliminated in the last tournament. We code the combination of these two elements in the following way: a) confidence of making it to the same round as in the last tournament (C); b) probability of winning the tournament from the round lost to in the last tournament (Wr). We calculate historical aspirations as a multiplicative term C*Wr.

To calculate the team's confidence that it will make it to the same round as the last tournament we use Wesley Colley's ranking method (Pasteur, 2010; Govan, 2008; Govan, Langville and Meyer, 2009). The Colley method is based on the Laplace rule of succession that estimates the probability of a future event using the previous frequency of this event. Based on this method, we calculate the confidence measure 'C' as follows: (1+self wins in the past)/(2+number of combats in the past tournament). Let us consider the following example as an illustration. Assume a team wins through round 1 -winning say two combats and losing none, in this 'only' multi-combat stage, and also winning the one combat in round 2 but losing in round 3. Let's assume that this leaves it with four combats to win including the round 3 combat for eventually winning the series. The probability of winning a combat is (½). Then C = (1+3)/(2+4) = 2/3; Wr is (1/2)*(1/2)* (1/2) *(1/2). Historical aspirations = C*Wr = 0.041.

Social Aspirations (SA_n): The setting of social aspirations combines the focal team's confidence C of reaching the same round in the forthcoming tournament as in the last one, with an estimate of the strength of the rival that eliminated the focal team from the tournament. To calculate social aspirations we once again use Colley's ranking method to calculate C, and multiply this by the rival team's probability of winning the next tournament based on the round it reached in the last tournament (Wrc). Let us illustrate with an example. Assume that our focal team, as in our above example, loses to a competitor that reached the semi-finals but was eliminated at that point. As before, the team calculates the confidence of reaching the semi-finals. Winning this particular tournament from the semi-finals onwards (two combats to be won) is (1/2)*(1/2), or (1/4). For the focal team i.e. winning the semi finals as one of two teams and winning the final as one of two finalists, this probability estimate referenced on the competitor's achievement is Wrc. Social aspirations here will be: C (same as for historical aspiration in this example)*Wrc = 0.166. It may be useful to note again that team assignment at the first stage of every contest series is random and; winning the series is the goal of every team that enters the tournament.

5.2.2 Inertia

Performance-Based Inertia (IN_n): Performance in tournament settings is about progressing to a certain stage i.e. achieving a certain performance level in the overall spread in performance that marks the population of competing teams. We use over time estimate of achieved progression as a proxy for performance-based inertia; which means that higher performance lowers the propensity to change the design (e.g. Miller and Chen, 1994, p. 14).

Performance-based inertia is thus coded as average performance levels reached by a team over the past tournaments. For example, if a team has participated in three tournaments and has reached stages '2, 2, and 3' respectively before being eliminated, performance-based inertia (INPn) is [2+2+3]/3 = 2.33.

Non-Performance-Based Inertia (INT_n): Organization researchers that study structural inertia argue that it is unaffected by performance (e.g. Stinchcombe 1965; Hannan and Freeman, 1977; Kelly and Amburgey, 1991; Guillen, 2002), but that it is strongly influenced by the age of the organization (Kelly and Amburgey, 1991, p. 593; Short and Palmer, 2003; Mol and Kotabe, 2011, p. 8; Desai, 2008). We therefore code non-performance-based inertia as the number of tournament series participated in by a team.

5.2.3. Controls

Contest Generation (Gn): Learning from performance in *Robot Wars* takes place against the background of population level accumulation of experience over successive generations, or tournaments of the contest. Each successive contest tournament can be seen as a generation that brings with it a pool of accumulated experiences of the population of teams from the previous generations. To test for the moderating impact of inertia on the discrepancy between performance and aspirations we must therefore control for experience that accumulates historically. We code the history of generations at the population level as Contest Generation *(Gn).* Contest generation is coded as '1' for the succession from tournament 1-tournament 2, '2' for tournament 2-tournament 3 and so on - till '6' for the succession from tournament 6-tournament 7. We use two different types of performance measures to operationalise our independent variables: competitive performance as determined by combat performance. Competitive performance has been coded as '1' if the team exits from the first round of the contest tournament; '2' if the team progresses to subsequent rounds but does not reach the semi-finals; '3' if the team reaches the semi-finals but is not the eventual tournament winner, and finally '4', if the team wins the tournament.

6. Analysis and results

We use moderated ordinal logistic regression (OLR) analysis to test the hypotheses, with inertia as a moderating predictor. Inertia as a moderating variable has an indirect effect on the outcome. This is through an influence on how another predictor variable impacts the outcome. We run three regression models (table 3). The third regression model comprising interactions relates directly with our hypotheses about moderating effect of the types of inertia on the relationship between types of aspiration aspirations and design change. This uses coefficients and the variance-covariance matrix from the first two model for standardization (Edwards and Lambert, 2007; Barnir, Hutchins, and Watson, 2011). Controlling for multi-collinearity in moderated regression is addressed by centering the data for regression (Aguinis, 1995, p. 1149).

Table 1 reports correlations and table 2 provides Variance Inflation Factor (VIF) as a multivariate test for collinearity (Craney and Surles, 2002). Associated tolerance levels for main predictor variables are also reported. VIF is lower than 5 for all predictors indicating that our regression model will be stable.

Insert Table 1 about here

Insert Table 2 about here

Population level experience is shown to inhibit design changes in all three regression models reported in table 3. Model 1 in table 3 shows aspiration effects and only social aspirations are significant as predictors of design change. Model 2 includes inertia effects; where neither of the two types of inertia is significant as predictor of design change. Model 3 (table 3) includes interaction effects showing moderation by each of the two types of inertia on the link between aspirations and design change. It continues to suggest a strong positive influence of social aspirations on design change and shows weak significance for performance-based inertia as an inhibitor of design change.

When we look at the hypotheses with the above analyses in mind we find the following: We find that contrary to the prediction stated in hypothesis 1, performance-based inertia as a moderating effect 'enhances' the link between historical aspirations and design change. We find support for hypothesis 2, i.e. performance-based inertia has a strong inhibiting effect on the link between social aspirations and design change (model 3, table 3). We find no support for hypothesis 3: Non performance-based inertia does not affect the relationship between historical aspirations and design change (model 3, table 3). Non-performance-based inertia does however have weakly significant negative influence on the relationship between social aspirations and design change providing support for hypothesis 4.

Insert Table 3 about here

7. **Discussion**

In all four interactions as moderating predictions, the hypothesized effect is negative. In other words, as their magnitude increases, the two types of inertia are expected to decrease design change when responding to attainment discrepancy - whether based on historical or social aspirations. When we look at our results, however, we see a mixed picture (see Table 4 for summary).

Insert Table 4 about here

The support that our results show for the second and fourth hypotheses is in accord with performance feedback theory. Generalizing the prediction of the second hypothesis that looks at the moderating effect of performance-based inertia on attainment discrepancy that is based on social aspirations, we would argue that essentially this suggests that decision makers with a long track of competitive success are less likely make major design changes if their aspirations are benchmarked against competitors. This is because they are likely to perceive attainment discrepancy as relatively less threatening than others who have lower performance-based inertia. In the case of the fourth hypothesis negative moderation of non-performance-based inertia is not due to confidence that arises from past performance but instead, arguably, it is due to internal team dynamics that constrain the ability of decision makers to respond to threats posed by an increasing attainment discrepancy.

The lack of support for the third hypothesis can be interpreted as evidence of the lack of a relationship between longevity and aspiration setting. In the context of *Robot Wars* this means that the number of tournaments in which teams participated, i.e. their longevity, had no impact on how they reacted to attainment discrepancy that is based on their recent performance, which in turn means that it had no impact on the extent of design changes. Because *Robot Wars* is a tournament that is played by teams with a tempo that alternates between focusing on the designing and building machines, and intense engagement in competition, it is possible that longevity does not have the same consequences as in established organizations where performance feedback is more continuous. It is also possible that longer history of participation in *Robot Wars* tournament influences the level of aspiration setting, which in turn leads to different interpretation of recent performance than would be the case for teams with shorter participation history. Research consistently shows that older organizations are more inertial than younger organizations (e.g. Kelly and Amburgey, 1991; Short and Palmer, 2003), in part because their survival tends to correlate positively with growth, but also because longevity fosters increasingly tight couplings between structures, policies, routines, and roles (Briscoe and Tsai, 2011). If we bear in mind that in this case attainment discrepancy is based on organization's own recent performance, then another plausible explanation is that age and increasingly complex internal interdependencies lead to an internal focus that constrain aspiration setting. When decision makers set aspirations based on their own recent performance, and when implementation of change is increasingly hampered by complex internal interdependencies, it can be argued that a preference for complacency may arise that will result in a preference for smaller attainment discrepancy (Labianca et al., 2009, 439). In the case of *Robot Wars* what we may be looking at is a correlation between longevity and increasing preference for "playing the game" rather than focusing on closing attainment discrepancies. This may be equivalent to managerial preference for a "quiet life" where managers prefer smooth operations rather than pursing decisions that involve disruptions and costly implementation efforts (Bertrand and Mullainathan, 2003).

We next turn our attention to the first hypothesis which is not supported, but which counter intuitively shows positive and significant results for the impact of performance-based inertia on attainment discrepancy based on historical aspirations. Our interpretation of performance-based inertia is that strong performance record is likely to lead decision makers to discount the implications of higher attainment discrepancy, whereas teams with weak performance record are more likely to see higher attainment discrepancy as pointing towards problems with their approach to design. If the latter happens, they are therefore likely to up their efforts to make changes that will deliver higher performance.

Our results, however, point in the opposite direction: Strong performance record seems to predict stronger response to attainment discrepancy. In other words, teams with strong record of performance up the extent of design change when the gap between aspirations and performance declines, rather than reduce it. This is consistent with research that shows that older organizations "become more confident in the appropriateness of their inherited strategies", and that "reinforcement of learning from success in older organizations leads to higher reliance on their own experience" (Blettner, 2015, p. 992). This also point to the possibility of overconfidence; of decision makers engaging in even more radical and potentially risky design changes rather than pull back and examine where things are going wrong. Miller (1990) argues that this kind of overconfidence is often found in high-flying entrepreneurs. In the cases he studied, high-flying entrepreneurs "seldom hesitated to back risky, long-term product development projects; they were all true believers in their firms' abilities to conquer all obstacles, technological, human, and financial" (Miller, 1990, p. 108). Overconfidence is not confined to high-flying entrepreneurs. In their discussion of the literature on overconfidence, Sandroni and Squintani (2013, p. 152) conclude that, "there is strong evidence that subjects underestimate risk on uncertain activities that they believe are under their control". Overconfidence means that when decision makers initiate actions they are more likely to believe that their ex ante planning and subsequent management of the situation can realize their aspirations than decision makers who have a more realistic view of the actual challenge. In the case of *Robot Wars* positive and significant result for the impact of performance-based inertia on the relationship between historical aspirations and design change suggests that a record of strong tournament performance increases decision makers' confidence in their ability to win. This confidence may lead them to discount the implications of higher aspiration discrepancy. They may attribute rising attainment discrepancy to bad luck, for instance unfortunate technical malfunction, or they may see the fall in recent performance as a personal challenge that should be met by making even more radical design changes. Since we lack comprehensive interview data that would allow for systematic analysis of how participants in *Robot Wars* react to rising attainment discrepancy, we can only speculate on how overconfidence leads to more design changes. What we can say with some certainty is that this behaviour is consistent with studies of overconfidence in a wide range of activities, both managerial and social.

8. **Limitations and Implications**

Our research design imposes a number of limitations on the generalizability of our results. To begin with, our research site is a tournament organized for teams of hobbyists who derive minimal pecuniary returns on their efforts. The generalizability from this research site to decision making in established organizations must be treated with caution. One can point to studies of teams that validate the application of performance feedback theory (Tushman and Romanelli, 1985; DeShon, Kozlowski, Schmidt, Milner, and Wiechmann, 2004; Lant and

Hurley, 1999). However, in spite of the parallels between teams and organizations, the decision making processes can be very different in each, which in turn means that the implications of our study have certain limits (Tekleab, Quigley, and Tesluk ; 2009).

Organizational structure, task responsibilities, and competition for resources mean that managers must negotiate reference points. It also means that politics can influence interpretation of performance. Whereas in our case reference points are well defined, and difficult to ignore, managers that design and market products generally operate in environments in which there are multiple reference points, and the selection of reference points is subject to internal debates within the organization's dominant coalition (Joseph and Gaba, 2015). Ultimately, therefore, our results may have valid implications for small organizations that are run by one individual, or a small team, that closely supervise the entire organization.

The structure of *Robot Wars* that lends clarity to our research design limits generalizability in another respect. A tournament is a competitive process with clearly demarcated entry and exit from the competition, full knowledge of rivals, and the consequences of rivalry, and precise performance that is available to all the participants. This structure focuses attention almost exclusive on competitive dynamics. While tournaments as a model for competitive interaction has been widely used (see Connelly et al., 2014), certain features of tournaments will infrequently mirror market competition. To begin with, performance in tournaments is only meaningful in relative terms. Thus, doing well is judged relative to the position of the actor relative to the position of rivals. So while for most firms' revenues or market share have tangible meaning in terms of performance, in a tournament context the only meaningful performance is rank positioning. In general terms, the parallels between teams competing in a tournament and firms competing in a market are therefore limited to certain aspects of the competition, for instance, situations of winner-take-all where firms try to get consumers to adopt their standards at the expense of all other competitors. These situations to some extent mirror elimination tournaments such as *Robot Wars*, but unlike *Robot Wars* even winner-take-all market situations rarely eliminate firms from the market; they usually force them to accept the dominant designs of their competitors (Argyres, Bigelow, and Nickerson, 2015).

9. **Conclusions**

Performance feedback theory is an analysis of what March (1978, p.592) refers to as "adaptive rationality", a model of decision making that emphasizes "experiential learning by individuals or collectivities". Experiential learning influences aspiration setting. To quote Blettner et al, (2015, p.991), an "organization gains experience in each period of its existence and recursively integrates learning from this experience as a basis for the subsequent aspiration level." Performance feedback theory, however, argues that inertia will influence experiential learning, and thus also influence aspiration setting.

In this paper we draw on organizational research to suggest that organizations may be subject to two types of inertia. Our paper examines the extent to which both types of inertia influence how decision makers respond to the gap between aspirations and performance. The negative moderation that we hypothesize suggests that decision makers are often excessively influenced by the past, both at the organizational and cognitive levels, a conclusion that is supported by prospect theory (Kacperczyk, Beckman and Moliterno, 2015; Sandroni and Squintani, 2013). When we look at the impact of performance-based inertia on attainment discrepancy based on self-referential aspirations we find a positive and statistically significant result. To policy makers and managers who supervise units that are allowed to set and evaluate their own targets, this should sound a cautionary note. It suggests that a strong track record will lead decision makers in these units to take on more risks when faced with higher attainment discrepancy. They may justify taking higher risks by pointing to their past track record, but as prospect theory seems to suggest, their extrapolation from the past to the future may be seriously biased (Holmes, Bromiley, Devers, Holcomb and McGuire, 2011).

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TABLE 1

Pearson Correlations

	D(n+1)	*G(n)*	*HA(n)*	*SA(n)*	*IN(n)*	*INT(n)*
Design change D (n+1)	1.00					
Generations (G(n))	**-0.28**	1.00				
Historical Aspirations (HA(n))	0.02	0.05	1.00			
Social Aspirations (SA(n))	**0.16**	-0.11	0.09	1.00		
Performance-based Inertia (IN(n))	-0.05	0.04	0.12	**-0.15**	1.00	
Non-Performance-Inertia (INT(n))	-0.02	**0.29**	0.07	-0.02	0.00	1.00

N= 169, Correlations of 0.15 or greater are significant at the 0.05 level

TABLE 2

Multi-collinearity Pearson Correlations and Variance inflation factor

Predictors/ independent variables	*VIF*	*tolerance level*
Generations (G(n))	4.54	0.22
Historical Aspirations (HA(n))	3.44	0.29
Social Aspirations (SA(n))	3.22	0.31
Performance-based Inertia (IN(n))	3.85	0.26
Non-Performance-Inertia (INT(n))	3.57	0.28

TABLE 3

Results of Ordinal Logistic Regression [b]: Explaining Design Change

PREDICTORS	Model 1	Model 2	Model 3	
[Control]				
Generation: G(n)	-0.31 * *(0.11)*	-0.31 * *(0.11)*	-0.029* *(0.10)*	
[Main effects]				
Historical Aspiration: HA(n)	0.14 *(0.008)*	-0.12 *(0.10)*	-0.74 *(0.41)*	
Social Aspiration: SA(n)	0.73 + *(0.27)*	0.77 + *(0.29)*	0.60 * *(0.11)*	
Perf. Based Inertia: IN(n)		-0.23 *(0.14)*	-0.91 + *(0.30)*	
Non Perf. Inertia : INT (n)		1.03 *(0.51)*	-1.10 *(0.48)*	
[Interactions]				
HA(n) x IN (n)			0.33 + *(0.10)*	**Hypothesis 1**
SA(n) * IN (n)			-0.84* *(0.15)*	**Hypothesis 2**
HA(n)* INT (n)			0.51 *(0.29)*	**Hypothesis 3**
SA(n) * INT (n)			-0.40 + *(0.13)*	**Hypothesis 4**
(Nagelkere's) Pseudo R^2	0.088	0.094	0.12	
c^2 *[df]*	10.1 [2]*	11.3 [8]*	19.8[8]*	

[b] Regression Coefficients and standard errors (in parentheses). Unstandardized coefficients have been reported. Number of observations: 169; + p <=0.10
** p <0.05*

Table 4: Summary of Results

Hypotheses	Results
As performance-based inertia increases teams that evaluate performance relative to historical aspirations will reduce design change.	The hypothesis is not supported. The results point in the opposite direction to the hypothesis: Stronger performance-based inertia increases the magnitude of design change if the discrepancy between aspirations and performance widen.
As performance-based inertia increases teams that evaluate performance relative to social aspirations will reduce design change.	The hypothesis is supported
As non-performance-based inertia increases teams that evaluate performance relative to historical aspirations will reduce design change.	The hypothesis is not supported
As no-performance-based inertia increases teams that evaluate performance relative to social aspirations will reduce design change.	The hypothesis is supported