Should Breguet's Boxed Chronometer No. 2741 Be Run?: The Potential of Decision-Making Protocols in Horological Conservation

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The question of whether or not clocks should be run is an important debate within horological conservation. Subjectivity, unfortunately, often has too much influence in the decision. This paper proposes the use of decision-making protocols in horological conservation to limit subjectivity and allow for standardized and consistent decision making. A case study will be made of Abraham-Louis Breguet's boxed chronometer No. 2741. The piece will first be put in its historical context and then a simplified decision-making protocol will be outlined and applied to answer the question of whether the chronometer should be run.

Abraham-Louis Breguet (1747-1823) is commonly heralded as one of the seminal figures in horology. He possessed a rare combination of exceptional ingenuity and gifted craftsmanship maximized by an ability to promote and sell his watches effectively. His contributions to horology include the tourbillon, parachute shock-proof bearings, a perpetual calendar system, a constant-force escapement and the *echappement nature*l escapement (Daniels,). Breguet was Swiss by birth but his family was of French Protestant heritage. He was apprenticed at Versailles and established his business in 1775. Breguet fled France during the 'Terror' after the French Revolution because of his ties to the former court. By 1795 he had returned to his Quai d'Horloge workshops in Paris and had begun the most fruitful period of his career. By 1813, the year he made No. 2741, Breguet had established himself at the pinnacle of horology and had an international clientele.

This first quarter of the 19th century was still the developmental period of chronometry. The mechanical solution to the longitude problem in the form of precise timekeepers had gained acceptance on both sides of the English Channel, winning out over the lunar table methods in the last years of the 1800s (Davidson, S., 2019). The major effects of temperature on chronometers had largely been neutralized by compensated balance wheels. As the timekeepers reached higher levels of precision, the issue of middle-temperature error became apparent in the compensation system. B. W. Hardy's 'Permanent Compensation Balance' is cited by von Bertele as the first attempt to address it (von Bertele, p.99). English chronometry was flourishing under a market-driven system that had begun in the late 18th century and had been dominated by Thomas Earnshaw and John Arnold. Arnold had died in 1799 and Earnshaw's patents for his spring detent design and bimetallic balance had expired, opening the lucrative market to other makers.

In contrast, the French system was marked by the royal patronage and appointment. Under this system, a Horloger de la Marine was appointed and made responsible for all production, repair, and service of marine chronometer for the French Navy. Louis Berthoud (1754-1813) This system encouraged more experimentation than in England but did not have the competition that led to advancement of the English system.

Breguet's renown eventually led to him being named Horloger de la Marine in 1815 upon the death of Louis Berthoud. But No. 2741 predates this appointment by two years. Breguet had demonstrated only limited interest in chronometry in the first

years of the 1800s. His first three marine chronometers were Nos. 104, 105, 106 with No. 106 selling in 1806. No more marine chronometers appear in Breguet's records until 1810 (Daniels p 84). Daniels identifies the period of 1808-1815 as one of experimentation with escapements by Breguet and this included for marine chronometers. It is at the tail end of this period of experimentation that Breguet created No. 2741. It is a one-day, fusee-driven marine clock with independent seconds and minute counters driven by a separate, spring-driven train. The escapement is a modified lever of Breguet's design that will be described below.

To determine whether this machine should be run, this paper proposes that a decision-making protocol be applied. Decision-making protocols emerged in the 1970s under pioneers C.H. Kepner and B.B. Tregoe. MORE Significant academic study of protocols has taken place since then but their application was largely limited to the field of business. Decision-making protocols, however, have appeared in conservation context. Myers proposed a systematic categorization of instruments in 1987 using protocols (Barclay.) Robert Barclay followed with the more refined protocol developed to determine if historic instruments should be played. This is a question closely related to the issue of running historic timepieces such as Breguet's 2741 and the proposed protocol in this paper has been adapted from Barclay's model.

Barclay's model uses assessments in three categories to determine if a musical instrument should be played: Rarity, Risk of Damage, and State. After assigning an instrument to one of several classifications within each of these categories, his protocol places the categories of Risk and Rarity on a matrix. By finding where the two classifications for that instrument meet on the matrix, an intermediate numerical value is assigned. This number is then placed on another matrix with the third category, Condition. A final numerical value is found at the point where the row for the intermediate numerical value meets the Condition classification column. He then applies the final numerical value to a standard describing what can be done with instruments according to their numerical value. At one extreme the numerical value 1 says that 'There are no circumstances under which the instrument should be played.' At the other end of the spectrum is a numerical value 13 which states that 'Any instrument with this score should have its presence in a collection of historic instruments reassessed.' (Barclay,)

Barclay does not address what seems to be one of the real strengths of his system. In his example, the first two categories were placed in the matrix to generate an intermediate number that was then put in another matrix with a different category to generate a final numerical value. This last category, therefore, has fifty percent (50%) influence in the final numerical value while the first two categories each have twenty-five percent (25%). By selecting which category is most important, it can be applied last so it has the highest level of influence. In a different case in which all three categories are deemed to be equally important, they can be rotated through the matrix positions generating three different numerical values. These values can then be averaged to generate a final numerical value with equal influence from the three different categories.

Decision-making protocols represent powerful and flexible tools that can be adapted and weighted according to each institution's needs and priorities. What if there are six major factors in a conservation question such as the running of a

timepiece? Depending on the priorities set by those implementing the protocol, two separate three-category combinations could be run following Barclay's model. The two numerical values generated could then be placed on a matrix together to generate a final numerical value. In this case the last category added in each of the three-category combinations would have a 25% influence and the first two categories would have 12.5% influence. This ability to weight certain categories represents a remarkable adaptability for different questions and different institutions in related to horological conservation.

Most importantly, the protocols limit the subjectivity in assessment of objects. It is understood that subjectivity will always be a factor in human decision making. In the case of the outlined decision-making protocol, it is the selection of the classification in each category for the object that is most vulnerable to this subjectivity. Precise definitions of classifications within categories will be the best way to restrict the influence of subjectivity in the decision.

The proposed decision-making protocol to determine if Breguet's marine chronometer No.2741 should be run will use three categories in the same way that Barclay has. They will be Rarity, Horological Significance and Condition. These categories and the classifications within each of them will be defined below as the Breguet piece is assessed. For this example, the category of Horological Significance will be prioritized and given the 50% influence. Rarity and Condition will be placed in the first matrix and therefore given 25% influence. Given the limitations of this paper, this is a simplified model designed primarily to illustrate the potential of a decision-making protocol to answer the question of whether a clock should be run. This simplification includes the assumption that the running of all clocks implies the same level of risk. It is acknowledged that this is not true. More categories could be added to the protocol in accordance with the demands or specifics of the class of timepieces and the institution that holds them. If a museum, for example, focuses more on the sociological aspects of objects it could include a Cultural Heritage category.

The category of Rarity in the proposed protocol can be understood to address simply how many examples like the object in question exist. Within that category five different classification would be made, borrowing from Barclay's model. See below for the graphic below.

Graphic 1

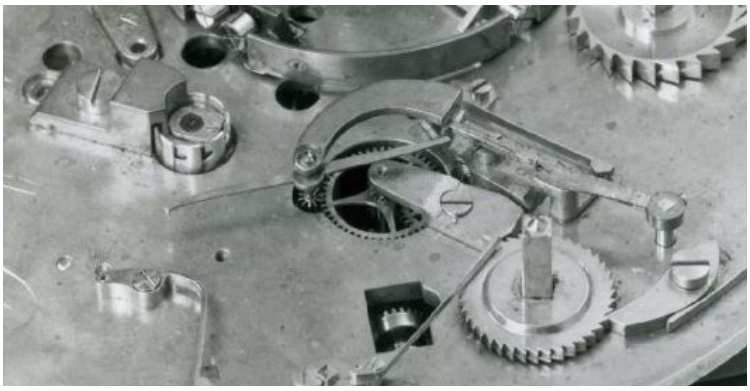
The first classification would be Unique. The definition be ' The only example of its type.' Rare 'One of a few examples of its type' Historic- Relatively scarce, and having some historical value. Common 'One of many extant, but no longer in production.' Replaceable- one of many extant and still in production.

George Daniels estimated that there were approximately ninety marine chronometer made by Abraham-Louis Breguet before his death.(Daniels,) Only a portion of those exist, though the number is not known. Once appointed Horloger de la Marine in 1815 Breguet's production moved toward a standardization of design. Removable platforms for escapements became common though Daniels points out that the goal of interchangeability of escapements was never achieved (Daniels,) No. 2741 predates Breguet's appointment and is a clear representation of a more

experimental period. The use of a lever escapement in a marine chronometer at this date is a rarity for Breguet. This was not a standard lever escapement of the era. The inscription on the movement cover refers to this feature. It reads 'The first piece where the transmission from the train to the regulator occurs without friction. Made in 1813 by Breguet for his friend, Mr. Belmas' (Translation by Randall, , p 143). Instead of a typical impulse pin on the balance wheel axis, this piece has a helix. This helix engages with a similarly shaped piece on the tail of the lever. This was an innovative attempt to keep engagement on the center line and to do so with limited friction (Daniels, p86)

No. 2741 also has an entirely engine-turned dial, a feature that Breguet seldom incorporated in a marine chronometer.

The second highly unusual aspect of this marine chronometer is the incorporation of a second train to power a seconds and minutes counter of elapsed time. This was, in effect, an early version of a chronograph. The design, attributed to Moyse Pouzait in 1777 by Good (p345) allows for the measurement of elapsed time by _____ with sliding activation on the side of the case. Given these factors, the classification of Breguet's No.2741 in the Rarity category would be 'Unique.'



Condition- This category would assess the current condition as well as the originality of the piece.

PERFECT	No traces of use, no damage or repairs, all components in place and all parts original
ORIGINAL	Limited damage and no repairs, all components in place, all parts original and obviously used but well maintained
USED	Showing signs of use and with some repairs, some parts not original but consistent with earlier state
ALTERED	Essentially fulfilling its function, evidence of heavy use and significant amount of replaced parts
TRANSFORMED	Functioning but in non-original state, with many parts replaced

The challenge in this category would be to set the definitions of classifications to reflect accurately the issues of repairs and alterations. Were the repairs well done by a prominent maker? If the institution determining if a clock should be run values alterations made by renown makers, then a timepiece might be put in a higher category because of a repair. This decision-making protocol used for Breguet 2741 does not reflect that view, instead prioritizing originality.

Based on visual inspection at the British Museum and the cataloging of Randall as well as written assessments by Good and Daniels, Breguet 2741 seems to be in original condition with limited if any repairs and replacement parts. The piece shows some brass pitting but is in excellent condition for its age (see image below). This would place the piece in the 'original' classification in the Condition category.

Breguet No.2741

Horological Significance- This category would assess the contribution the piece made to the field of horology. The classifications within the category are found below.

Exceptional 'The piece incorporates innovative and long-lasting solutions to horological problems and aesthetics.' High 'The piece has creative problem-solving components that did not have a lasting effect but nonetheless show high-levels of mastery' medium 'The piece shows typical work of a highly-regarded horologist but is not exceptional within their body of work'
Low 'The timepiece is not innovative in its design or manufacture or exceptional in esthetics'

Breguet's 2741 would be assessed as 'high' in the category of horological significance. The chronometer shows innovative expression in the lever escapement with helical attachments as well as the incorporation of the early form of chronograph. Neither of these designs persisted in horology, preventing a classification of the object at the highest 'exceptional' level. This classification would be reserved for timepieces of the highest horological importance such as the one incorporating Mudge's first lever escapement. Although Breguet No. 2741 does not meet this level, the piece is exceptional within Breguet's body of work for its innovation and consistent with his high level of finish.

By placing Condition and Rarity in the first matrix with the classifications of Unique for Rarity and Original for Condition, a numerical value of 4 is generated (See graphic below). When this intermediate numerical value is placed on a second matrix with the High classification for Horological Significance category, a final numerical value of 8 is found for Breguet 2741.

Graphic

blah						

Part of the protocol development would be defining the meaning of final numerical values, as Barclay did for the instruments, and then designating thresholds. In this case, the protocol would be used to determine whether a piece should be run. To help set the threshold value above which a timepiece should not be run it is important to understand the benefits and problems related to the running of a timepiece. The benefits of running a timepiece are two-fold. The first benefit is the pure appeal of seeing the machine in motion. While this may seem trivial, with dynamic objects it is a core component of the non-monetary value; these objects were designed and made to be run. In a museum setting, this also could mean greater interest from the public and therefore more revenue from tickets sold. The second benefit of running a timepiece would be to understand and appraise the design and function of its movement. In the case of the timepiece in question, this would include the distinctive features of the chronograph and the lever with helix escapement.

The drawbacks of running the movement are the resultant wear on parts and therefore the loss of original material and also the risk of breakage of parts. Running the movement also implies that the movement must be cleaned and re-lubricated periodically. All lubricants require change if they are to protect parts. The process of disassembly, cleaning and reassembly carry with them the risk of breakage as well as the risk implied with handling and moving the chronometer associated with its cleaning.

There are three possible scenarios for which thresholds should be set for the running of timepieces and the Breguet in question:

1) The marine chronometer should be run regularly

2) The marine chronometer should be run periodically

3) The marine chronometer should never be run

On the other hand, constant running implies the highest level of wear and risk of breakage of part. This loss of original material and risk are not easily quantified.

The scenario of limited running does imply reduced wear. Due to lubricant spread, it would require running at least once per month with the necessary handling to perform winding every eight-days or in the case of limited running, winding once per month. Beyond this, the life of lubricants is limited and therefore, to be running the piece periodically implies a full cleaning every five years.

It can be determined based on this information that in the proposed protocol any object with a numerical value of 7 or above, should not be run. Timepieces with a final numerical value of 5 or 6 or could be run but only periodically. With timepieces with 3 or 4 could be run regularly. The same protocol could be used to make other collections management decisions. The numerical value of 3 could be the threshold for a piece to receive conservation resources and also serve as a deaccension threshold value in an institution with limited resources.

The protocol therefore shows that Breguet no.2741 should not be run. This decision took into account the object's rarity, condition and horological significance. This seems to be a sound assessment. The object is rare, in good condition, has innovative expression by a renowned making and shows high level of finish. An

argument not to run the timepiece could easily have been made without a decision-making protocol but the virtues of the protocol are that they limited subjectivity in the decision and would allow for another object to be assessed following a repeatable pattern.

Decision-making protocols offer more to horological conservation than simply deciding if a clock should be run should be run. In a conservation world of limited resources of time and money, decision making protocols could be used to determine which pieces receive conservation resources, which pieces should be acquired and which pieces should be deaccessioned, as Barclay's model suggests.

Decision-making protocols have significant potential in horological conservation. The offer a method of limiting subjectivity in decision making and the possibility of repeatable and quantifiable standards of assessment that can serve multiple purposes in horological conservation. Conservation is a discipline with limited and shrinking resources of time and money and these protocols can help make sure that those resources are allotted in the most efficient areas. In the case of Breguet 2741, the example decision-making protocol established that the piece was well above the threshold numerical value and should not be run. The piece is an important part of horological history for several reasons and the risks and inevitable loss of original material associated with its running are unacceptable.

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